

A brief review of animal parasites recorded in Western Province, Papua New Guinea

urn:lsid:zoobank.org:pub:BF49E0F0-7256-4157-88CC-04A62BAEF719

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Abstract: Papua New Guinea's Western Province has a rich biodiversity of both animal hosts and parasites. In the text, hosts are arranged into three groups: non-native domestic animals, long-established domestic animals, and wildlife, while they are listed systematically in a table. The range of animals in the first and second groups is small and harbours mainly parasites commonly found in domestic animals. The wildlife group contains an extensive range of host animals and parasites. Rusa deers are unusual, as herding animals, in having no nematode parasites. Wild pigs, besides having nematodes commonly found in suids, carry a zoonotic nematode in the musculature and one, unique to the country, in the tongue. Digenetic trematodes are almost the only parasites recorded from dugongs. Amongst 12 species of bats, virtually no endoparasites are recorded in frugivores but ectoparasites were present on both frugivores and insectivores. Fleas were the main ectoparasites of the 24 species of rodents identified to species, particularly in the north of the province, while nematodes were the predominant endoparasites. Twenty-one species of marsupials, identified to species, were examined. Nematodes formed the majority of the endoparasites of wallabies, while the smaller marsupials (bandicoots, dunnarts and possums) harboured a relatively small range of ecto- and endo- parasites. Thirty-six bird species were examined, with ectoparasites (chewing or feather lice in particular) being more frequently found than endoparasites. One case of brood parasitism by a bird is recorded, as well as two species of arthropods (a louse and a mite), normally parasites of mammals, infesting a bird (a cassowary). Parasites of lower vertebrates have received little study and consequently only a small number are recorded from reptiles, amphibia and fishes. Some parasites and parasitoids, mostly insects and brood parasitizing birds, with no named hosts, are included in a separate table. Some species of rodents, marsupials and reptiles, together with their parasites, occur in both Western Province and northern Australia and is a legacy of the physical connection that linked the localities in the past.

Key words: Hosts, domestic animals, wildlife, ectoparasites, endoparasites, helminths, arthropods, annelids, New Guinea.

Introduction

Parasites are an integral part of nature. They can play a part in the process of evolution through their influence on their hosts and their own adaptation to the environment which they have adopted. Although parasites of wildlife, under natural conditions, seldom appear to have obvious harmful effects on their hosts, nevertheless, they probably participate in the 'survival of the fittest' by helping to weed-out the weakest members of the host species. As can be seen in this account, scarcely any of the animals examined, with the exception of a few marsupials, harboured sufficient numbers of parasites that would likely affect their well-being. The exceptions were wallabies and pademelons in which large numbers and a variety of species of worms were found. Such numbers are

most often associated with domestic animals when they are confined to limited space which becomes heavily contaminated with infective stages of internal parasites or when animals are kept in close contact which facilitates the spread of parasitic arthropods. The habit, at least of agile wallabies, of grazing in groups may be part of the explanation, but the host-parasite association suggests it to be a well-established and well-tolerated association that has no obvious ill-effect on the health of the host animals.

Western Province (further in text – WP) lies in the southwest corner of Papua New Guinea (further in text – PNG), bordered in the north and east by Sandaun (West Sepik), Hela, Southern and Gulf provinces, in the south by Torres Strait and in the west by the Indonesian province of Papua (Fig. 1). It is by far the largest province in PNG, with



an area of 99300km², and is sparsely populated - a population of about 200000 with an average density of 2.1 persons per square km - with poor infrastructure. Most of the province is low lying with much swamp-land but rises in the north-northeast in a series of steep-sided ranges, that include the Star Mountains, Hindenburg, Victor Emanuel, Blucher and Muller ranges with an average height of 3000 meters (Fig. 2). These form the source of two major WP river systems, the Fly River and its

main tributary, the Strickland. A large open-cast copper and gold mine is located at Ok Tedi in the Star Mountains, that has had a profound effect on the immediate environment of the mine site and, downstream, on the character of Ok Tedi and Fly rivers.

WP has a wet climate with tropical rainforest cover, other than in the southern Trans Fly portion which has distinct wet and dry seasons with tropical savannah woodlands dominated by *Melaleuca*

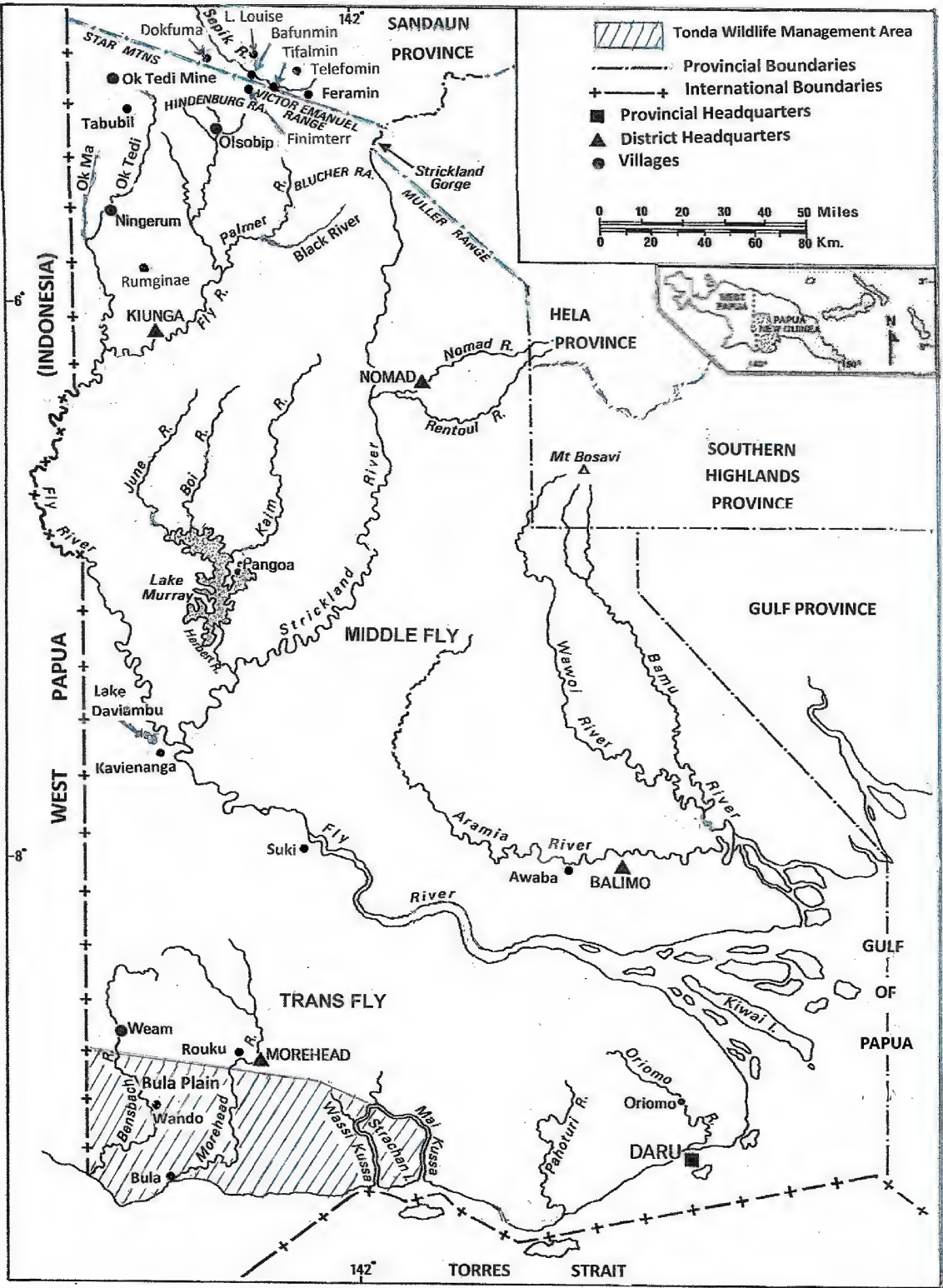


Figure 1. Map of Western Province, Papua New Guinea, showing locations of sites mentioned in the text and tables 1 & 2.



Linnaeus, 1767 and *Acacia* Linnaeus, 1773 species. Much of this area can be flooded in the wet season (approximately December - April) while experiencing drought conditions in the dry period (Fig. 3). The province has a rich fauna, due in part, probably, to the sparseness of the population and consequently a lack of intensive hunting, although this has increased in recent years in parts of Trans Fly. The remote south-west Bula Plain / Bensbach River area is noted for its variety of permanent and migratory birds, is designated as a wildlife protected zone, the Tonda Wildlife Management Area, and was declared a Ramsar Site in 1993.

This account is a compilation based on surveys carried out by the author, mostly in the Tonda Wildlife Management Area (Fig. 1), and on parasite collections and data published by other researchers, notably Drs I. Beveridge, L. Smales and M. Hastriter, from this area and elsewhere in the province, including locations straddling the border of WP and Sandaun Province. The catalogue, probably, comprises of only a fraction of the parasite diversity; it is likely that much remains to be discovered in the rich wildlife of the province.

Hosts and their parasites are listed in Table 1 together with host localities and the locations of parasites in/on their hosts. Parasites of domestic animals are included but form only a small part of the account. Parasites that have no named hosts are included in Table 2. As will be noted, many parasites discovered remain to be identified. Host nomenclature is based largely on the following sources: rodents and marsupials – Flannery (1995); bats – Bonaccorso (1998); birds – Beehler & Pratt (2016); varanids – Pianka, King & King (2004); chelids – Kennett *et al.* (2014); amphibians - Menzies (2006); freshwater fishes – Allen (1991). Parasites are arranged systematically to ordinal level and the generally accepted mode of classification is followed.

A local artist, John Siune, from Simbu Province (PNG), has depicted examples of PNG / WP parasites in Fig. 4 – using much artistic liberty – and, with similar liberty, produced illustrations of host animals (Figs 5–6). Although not scientific, the illustrations convey the uniqueness of the country and its culture.



Figure 2. The mountainous north of Western Province: part of the Hindenburg Wall at the border with Sandaun Province.





Figure 3. A dust cloud raised by the vehicle draws attention to the bone-dry condition of Bula Plain in the south west of Western Province during the dry season; the stranded canoe signifies the mode of transport required in the wet season when the area can be under a meter of water (image courtesy Eric Lindgren, October 1969).

Results

Table 1. Parasites of animals recorded in Western Province, Papua New Guinea.

Host Group	Host	Location in Western Province	Parasite Group	Parasite	Location in host
Mammals (equids)	Horse (Timor Pony) <i>Equus caballus</i> (Linnaeus, 1758)	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Habronema</i> sp. (larvae)	Associated with 'swamp cancer' lesions
	"	Bula Plain/Bensbach	Insecta (Diptera)	<i>Chrysomya bezziana</i> Ville-neuve, 1914 (larvae)	Wounds
Mammals (canids)	Dog (Domestic/Feral) <i>Canis familiaris</i> Linnaeus, 1758	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Ancylostoma caninum</i> (Ercolani, 1859)	Small intestine
	"	Suki	Nematoda (Spirurida)	<i>Dirofilaria immitis</i> (Leidy, 1856)	Pulmonary artery, ventricle
	"	Bultem village near Tabubil	Insecta (Phthiraptera)	<i>Heterodoxus spiniger</i> (Enderlein, 1909)	Body surface
	"	Bula Plain/Bensbach	Insecta (Diptera)	<i>Chrysomya bezziana</i> Ville-neuve, 1914 (larvae)	Wounds
	"	Bula Plain/Bensbach	Insecta (Siphonaptera)	<i>Ctenocephalides felis felis</i> (Bouché, 1835)	Body surface
Mammals (suids)	Pig (Domestic/Wild) <i>Sus scrofa</i> (Linnaeus, 1758)	Bula Plain/Bensbach	Protozoa (Ciliophora)	<i>Balantidium coli</i> (Malmsten, 1857)	Caecum, colon
	"	Bula Plain/Bensbach	Cestoda (?Pseudophyllidea)	Unidentified larval tapeworms (?sparganum')	Vascular/lymph system
	"	Bula Plain/Bensbach	Nematoda (Enoplida)	<i>Capillaria papuensis</i> Copland, 1975	Tongue tissue
	"	Bula Plain/Bensbach	Nematoda (Enoplida)	<i>Trichinella papuae</i> Pozio et al., 1999	Adults in s. int., larvae in muscle
	"	Bula Plain/Bensbach	Nematoda (Enoplida)	<i>Trichuris suis</i> (Schrank, 1788)	Large intestine, caecum
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Metastrongylus pudendotectus</i> (Vostokov, 1905)	Lungs
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Oesophagostomum quadrispinulatum</i> (Marcone, 1901)	Large intestine
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Stephanurus dentatus</i> Diesing, 1839	Perirenal fat, thoracic fascia



Table 1 (continuation)

	"	Bula Plain/Bensbach	Nematoda (Ascaridida)	<i>Ascaris suum</i> Goeze, 1782	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Gnathostoma doloresi</i> Tubangu, 1925	Stomach
	"	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Setaria (Artionema) thomasi</i> (Sandosham, 1954)	Peritoneal cavity
	"	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Physocephalus ? sexalatus</i> (Molin, 1860)	Stomach
	"	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Simondsia paradoxa</i> Cobbold, 1864	Stomach
	"	Bula Plain/Bensbach	Acanthocephala (Oligacanthorhynchida)	<i>Macracanthorhynchus hirudinaceus</i> (Pallas, 1781)	Small intestine
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Haematopinus suis</i> (Linnaeus, 1758)	Body surface
	"	Bula Plain/Bensbach	Insecta (Siphonaptera)	<i>Ctenocephalides f. felis</i> (Bouché, 1835)	Body surface
	"	Bula Plain/Bensbach	Acari (Sarcoptiformes)	<i>Sarcoptes scabiei</i> (Linnaeus, 1758)	Skin
Mammals (ruminants)	Cattle (European/Asian) <i>Bos Taurus / Bos indicus</i> Linnaeus, 1758	Oriomo	Insecta (Diptera)	<i>Chrysomya bezziana</i> Villeneuve, 1914 (larvae)	Wounds
	"	Suki	Insecta (Diptera)	<i>Haematobia irritans exigua</i> (Meijere, in Schat, 1903)	Body surface
	"	Awaba, Balimo, Daru, Oriomo, Rumginae, Suki	Acari (Ixodida)	<i>Rhipicephalus (Boophilus) australis</i> (Fuller, 1899)	Body surface
	Goat <i>Capra hircus</i> (Linnaeus, 1758)	Samagos village near Kiunga	Nematoda (Rhabditida)	<i>Strongyloides</i> sp.	Small intestine
	"	Samagos village near Kiunga	Nematoda (Strongylida)	<i>Haemonchus contortus</i> (Rudolphi, 1803)	Abomasum
	"	Samagos village near Kiunga	Nematoda (Strongylida)	<i>Oesophagostomum columbianum</i> Curtice, 1890	Large intestine
	"	Samagos village near Kiunga	Nematoda (Strongylida)	<i>Trichostrongylus</i> sp.	Small intestine
	Rusa Deer <i>Cervus timorensis</i> Blainville, 1822	Bula Plain/Bensbach	Protozoa (Piroplasmorida)	<i>Theileria mutans</i> (Theiler, 1906)	Red blood cells
	"	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Fischoederius elongatus</i> (Poirier, 1883)	Rumen
	"	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Homalogaster paloniae</i> Poirier, 1883	Caecum
	"	Bula Plain/Bensbach	Insecta (Diptera)	<i>Chrysomya bezziana</i> Villeneuve, 1914 (larvae)	Wounds
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Rhipicephalus (Boophilus) australis</i> (Fuller, 1899)	Body surface
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Amblyomma papuanum</i> Hirst, 1914	Body surface
Mammals (Sirenia)	Dugong/Sea Cow <i>Dugong dugon</i> (Müller, 1776)	Daru Is., Gulf of Papua	Trematoda (Digenea)	<i>Indosolenorchis hirudinaceus</i> Crusz, 1951	Large intestine, caecum
	"	Daru Is., Gulf of Papua	Trematoda (Digenea)	<i>Opisthotrema dujonis</i> (Leuckart, 1874)	Eustachian tube, middle ear, oesophagus
	"	Daru Is., Gulf of Papua	Trematoda (Digenea)	<i>Cochleotrema indicum</i> Sharma et Gupta 1971	Nasal passages, lungs
	"	Daru Is., Gulf of Papua	Trematoda (Digenea)	<i>Lankatrema minutum</i> Blair, 1981	Cardiac gland of stomach
	"	Daru Is., Gulf of Papua	Trematoda (Digenea)	<i>Lankatrematoides gardneri</i> Blair, 1981	Pancreatic ducts
	"	Daru Is., Gulf of Papua	Trematoda (Digenea)	<i>Foliotrema jecoris</i> Blair, 1981	Gall bladder, bile ducts
	"	Daru Is., Gulf of Papua	Nematoda (Ascaridida)	<i>Paradujardinia halicoris</i> (Owen, 1833)	Cardiac gland of stomach
Mammals (bats, Megachiroptera)	Greater Bare-backed Bat <i>Dobsonia moluccensis</i> (Quoy et Gaimard, 1830)	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Meristaspis jordani</i> (Radford, 1947)	Body surface
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Neolaelaps vitzthumi</i> Domrow, 1961	Body surface
	Big-eared Flying Fox <i>Pteropus macrotis epularius</i> Ramsay, 1878	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Neolaelaps vitzthumi</i> Domrow, 1961	Body surface
	Spectacled Flying Fox <i>Pteropus conspicillatus</i> Gould, 1850	Bula Plain/Bensbach	Diptera (batflies)	<i>Cyclopodia</i> (C.) sp. (sykesii group)	Body surface



Table 1 (continuation)

	"	Bula Plain/Bensbach	Diptera (batflies)	<i>Nycteribia p. parilis</i> Walker, 1861	Body surface
	Flying Fox <i>Pteropus</i> sp.	?	Protozoa (Haemosporida)	<i>Hepatocystis</i> sp. + a malaria-like blood parasite	Red blood cells
	"	?	Nematoda (Spirurida)	microfilariae	Blood
	Common Rousette Bat <i>Rousettus amplexicaudatus</i> (Geoffroy, 1810)	Bula Plain/Bensbach	Diptera (batflies)	Species not identified	Body surface
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Meristaspis</i> sp. nr. <i>lateralis</i> (Kolenati, 1856)	Body surface
	Common Blossom Bat <i>Syconycteris australis</i> (Peters, Siphonaptera)	Ok Tedi	Diptera (batflies)	<i>Cyclopodia</i> s. <i>sycophanta</i> Maa, 1971	Body surface
Mammals (bats, Microchiroptera)	Large-eared Sheath-tailed Bat <i>Emballonura diana</i> <i>fruhstorferi</i> Flannery, 1994	Black River, Blucher Range	Cestoda	Species not identified	Small intestine
	"	Black River, Blucher Range	Nematoda	Species not identified	Small intestine
	Raffray's Sheath-tailed Bat <i>Emballonura</i> r. <i>raffrayana</i> (Dobson, 1879)	Black River, Blucher Range	Acari (Mesostigmata)	<i>Meristaspis calcarata</i> (Hirst, 1923)	A <i>Pteropus</i> sp. mite - an accidental infestation
	Lesser Sheath-tailed Bat <i>Mosia nigrescens</i> (Gray, 1843)	Ok Tedi	Trematoda (Digenea)	? <i>Paralecithodendrium</i> sp.	Small intestine
	Diadem Leaf-nosed Bat <i>Hipposideros diadema griseus</i> (Meyen, 1833)	Black River, Blucher Range	Nematoda	2 species not identified	Stomach/small intestine
	Fawn Leaf-nosed Bat <i>Hipposideros cervinus</i> (Gould, 1854)	Black River, Blucher Range	Nematoda	2 species not identified	Stomach/small intestine
	"	Black River, Blucher Range	Acari (Mesostigmata)	Species not identified	Body surface
	New Guinea Horseshoe Bat <i>Rhinolophus euryotis timidus</i> Anderson, 1905	Black River, Blucher Range	Trematoda (Digenea)	<i>Parabascus</i> sp.	Stomach/duodenum
	"	Black River, Blucher Range	Cestoda	Species not identified	Intestine
	"	Black River, Blucher Range	Nematoda	Species not identified	Stomach/small intestine
	"	Black River, Blucher Range	Acanthocephala	Species not identified	Stomach/small intestine
	Bent-winged Bat <i>Miniopterus</i> sp.	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Paralecithodendrium chilostomum</i> (Mehlis, 1831)	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Ascaridida)	<i>Seuratum</i> sp.	Intestine
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Spinturnix wilsoni</i> Prasad, 1969	Body surface
Mammals (rodents, Muridae Hydromyini)	Northern Hydromyine <i>Paraleptomys rufilatus</i> Osgood, 1945	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	"	Bafunmin	Insecta (Siphonaptera)	<i>Striopsylla vandeuseni</i> Holland, 1969	Body surface
	Short-haired Hydromyine <i>Paraleptomys wilhelmina</i> Tate et Archbold, 1941	Bafunmin, Feramin	Trematoda (Digenea)	<i>Brachylaima</i> sp.	Small intestine
	"	Bafunmin, Feramin	Nematoda (Ascaridida)	<i>Heterakis fieldingi</i> Smales, 1996	Large intestine
	"	Bafunmin, Feramin	Nematoda (Spirurida)	<i>Protospirura kainiensis</i> Smales, 2001b	Stomach
	"	Bafunmin	Insecta (Siphonaptera)	<i>Traubia</i> (<i>Kuruopsylla</i>) <i>kuru</i> Holland, 1969	Body surface
	"	Bafunmin	Insecta (Siphonaptera)	<i>Rectidigitus spooneri</i> Rothschild, 1934	Body surface
	Hydromyine <i>Paraleptomys</i> sp.	Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Acanthopsylla eudromiciae</i> Holland, 1969	Body surface
	"	Bafunmin	Insecta (Siphonaptera)	<i>Orthopsyllodes</i> (O.) <i>uncinata</i> Hastriter, 2014	Body surface
	"	Bafunmin	Insecta (Siphonaptera)	<i>Striopsylla vandeuseni</i> Holland, 1969	Body surface



Table 1 (continuation)

Mammals (rodents, Muridae Uromyini)	Menzies' Mouse <i>Abeomelomys sevia</i> (Tate et Archbold, 1935a)	Telefomin	Nematoda (Strongylida)	<i>Montistrongylus karungi</i> Smales, 2012	Small intestine
	"	Telefomin	Nematoda (Strongylida)	<i>Odilia mackerrasae</i> (Mawson, 1961)	Small intestine
	"	Telefomin	Nematoda (Ascaridida)	<i>Heterakis</i> sp.	Large intestine
	"	Telefomin	Nematoda (Ascaridida)	<i>Ophidascaris</i> larvae	Small intestine
	Uneven-toothed Rat <i>Anisomys imitator</i> Thomas, 1904a	Telefomin	Insecta (Siphonaptera)	<i>Rectidigitus szentivanyi</i> Holland, 1969	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Rectidigitus traubi</i> Holland, 1969	Body surface
	"	Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Traubia</i> (T.) <i>durdeni</i> Hastriter, 2015	Body surface
	"	Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Traubia</i> (T.) <i>egregia</i> Smit, 1953	Body surface
	"	N.E. of Telefomin	Insecta (Siphonaptera)	<i>Traubia</i> (T.) <i>traubi</i> Hastriter, 2015	Body surface
	"	N.E. & N.W. of Telefomin	Insecta (Siphonaptera)	<i>Traubi</i> (<i>Kuruopsylla</i>) <i>kuru</i> Holland, 1969	Body surface
	"	N.W. of Telefomin	Acari (Ixodida)	<i>Ixodes priscicollaris</i> Schulze, 1932	Body surface
	Rümmler's Mouse <i>Coccymys rümmleri</i> (Tate et Archbold, 1941)	Star Mountains	Insecta (Siphonaptera)	<i>Acanthopsylla eudromiciae</i> Holland, 1969	Body surface
	"	Star Mountains	Insecta (Siphonaptera)	<i>Striopsylla bifurcata</i> Hastriter & Easton, 2013	Body surface
	"	Star Mountains	Insecta (Siphonaptera)	<i>Tiflovia stellalpestris</i> Traub, 1977	Body surface
	"Giant rat"	Star Mountains	Insecta (Siphonaptera)	<i>Acanthopsylla richardsoni</i> Smit, 1953	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Rectidigitus szentivanyi</i> Holland, 1969	Body surface
	Eastern White-eared Giant Rat <i>Hyomys goliath</i> (Milne-Edwards, 1900)	N.E. of Telefomin	Insecta (Siphonaptera)	<i>Traubia</i> (T.) <i>traubi</i> Hastriter, 2015	Body surface
	"	Telefomin	Acari (Ixodida)	<i>Ixodes goliath</i> Apanaskevich et Lemon, 2018	Body surface
	Long-footed Tree Mouse <i>Lorentzimys nouhuysii</i> Jentink, 1911a	Star Mountains	Nematoda (Strongylida)	<i>Hasanuddinia</i> sp.	Small intestine
	"	Bafunmin	Nematoda (Oxyurida)	<i>Syphacia lorentzimys</i> Smales 2010.	Large intestine
	"	Telefomin	Nematoda (Oxyurida)	<i>Syphacia mamelonitenuis</i> Smales, 2010	Large intestine
	Rothschild's Woolly Rat <i>Mallomys rothschildi</i> Thomas, 1898	Bafunmin	Insecta (Siphonaptera)	<i>Rectidigitus spooneri</i> Rothschild, 1934	Body surface
	Large-scaled Mosaic-tailed Rat <i>Mammelomys lanosus</i> (Thomas, 1922a)	Tifalmin	Nematoda (Strongylida)	<i>Cyclodontosomum purvisi</i> Adams, 1933	Small intestine
	"	Tifalmin	Nematoda (Strongylida)	<i>Odilia mackerrasae</i> (Mawson, 1961)	Small intestine
	"	Tifalmin	Nematoda (Strongylida)	<i>Parvinema bafunminensis</i> Smales, 2017	Small intestine
	"	Tifalmin	Nematoda (Ascaridida)	<i>Subulura</i> sp.	Caecum
	"	Tifalmin	Nematoda	Unidentified larvae	Small intestine
	"	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	"	Bafunmin, Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Striopsylla vandeuseni</i> Holland, 1969	Body surface
	"	Bafunmin	Insecta (Siphonaptera)	<i>Orthopsylloides</i> (O.) <i>uncinata</i> Hastriter, 2014	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Wilsonipsylla spinicoxa</i> Hastriter, 2012	Body surface
	Papua Grassland Melomys <i>Melomys lutillus</i> (Thomas, 1913)	Bula Plain/Bensbach + Star Mountains (Bafunmin)	Cestoda (Cyclophyllidea)	<i>Raillietina celebensis</i> (Janicki, 1902)	Intestine
	"	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	Species not identified	Intestine
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Odilia mackerrasae</i> (Mawson, 1961)	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Odilia melomyos</i> (Mawson, 1961)	Small intestine



Table 1 (continuation)

	"	Bula Plain/Bensbach	Nematoda (Oxyurida)	<i>Syphacia darwini</i> Hugot et Quentin, 1985	Intestine
	"	Bula Plain/Bensbach	Nematoda	2 species not identified	Intestine
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Haemaphysalis humerosa</i> Warburton et Nuttall, 1909 (nymphs)	Body surface
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Laelaps rothschildi</i> Hirst, 1914	Body surface
	Melomys <i>Melomys</i> spp.	Dokfuma	Nematoda (Strongylida)	<i>Hughjonestrongylus mirzai</i> (Smales, 2009)	Small intestine
	"	Dokfuma	Nematoda (Strongylida)	<i>Melomysstrongylus sepikensis</i> Smales, 2009	Small intestine
	"	Bula Plain/Bensbach	Nematoda	Species not identified	Duodenum
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Hoplopleura</i> sp.	Body surface
	"	Trans Fly (Eramoe)	Insecta (Siphonaptera)	<i>Orthopsylloides (Mirzapsylla) andersoni</i> George et Beaucournu, 1995	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Orthopsylloides (O.) uncinata</i> Hastriter, 2014	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Rectidigitus szentivanyi</i> Holland, 1969	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Rectidigitus traubi</i> Holland, 1969	Body surface
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Haemaphysalis humerosa</i> Warburton et Nuttall, 1909 (nymphs)	Body surface
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Laelaps rothschildi</i> Hirst, 1914	Body surface
	"	Bula Plain/Bensbach	Acari (Trombidiformes)	'chiggers'	Body surface
	"	Bula Plain/Bensbach	Acari	Species not identified	Body surface
	Lorentz's Paramelomys <i>Paramelomys lorentzii</i> (Jentink, 1908)	Star Mountains	Nematoda (Enoplida)	<i>Capillaria</i> s. l.	Duodenum, caecum
	"	Bafunmin, Tifalmin, Telefomin	Nematoda (Strongylida)	<i>Parvinema bafunminensis</i> Smales, 2017	Small intestine
	"	Bafunmin	Nematoda (Strongylida)	<i>Parvinema helgeni</i> Smales, 2017	Small intestine
	"	Bafunmin	Nematoda (Strongylida)	<i>Equilophos similis</i> (Smales, 2009)	Small intestine
	"	Bafunmin	Nematoda (Strongylida)	<i>Macrostrongylus ingens</i> Smales, 2008	Small intestine
	"	Bafunmin	Nematoda (Strongylida)	<i>Odilia mackerrasae</i> (Mawson, 1961)	Small intestine
	"	Bafunmin	Nematoda (Strongylida)	<i>Hughjonestrongylus mirzai</i> (Smales, 2009)	Small intestine
	"	Bafunmin	Nematoda (Strongylida)	<i>Heligmonellid</i> spp.	Small intestine
	"	Bafunmin	Nematoda (Strongylida)	<i>Cyclodontostomum purvisi</i> Adams, 1933	Caecum
	"	Bafunmin	Nematoda (Ascaridida)	Ascaridiinae larvae	Body cavity
	"	Bafunmin	Nematoda (Oxyurida)	<i>Syphacia longaecausta</i> Smales, 2001a	Caecum
	"	Bafunmin	Nematoda (Spirurida)	<i>Protospirura kainiensis</i> Smales, 2001b	Stomach
	"	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	"	Bafunmin	Insecta (Siphonaptera)	<i>Rectidigitus claviculatus</i> Hastriter, 2016	Body surface
	"	Star Mountains	Insecta (Siphonaptera)	<i>Rectidigitus glomerospinosus</i> Hastriter, 2016	Body surface
	Lowland Paramelomys <i>Paramelomys platyops</i> (Thomas, 1906)	Bafunmin	Insecta (Siphonaptera)	<i>Orthopsylloides (O.) uncinata</i> Hastriter, 2014	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Orthopsylloides (O.) orthodactylus</i> Holland, 1969	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Traubia (Kuruopsylla) kuru</i> Holland, 1969	Body surface
	"	Telefomin	Acari (Ixodida)	<i>Ixodes priscicollaris</i> Schulze, 1932	Body surface
	Mountain Mosaic-tailed Rat <i>Paramelomys rubex</i> (Thomas, 1922a)	Mabiomskin (near Ok Tedi Mine)	Cestoda (Cyclophyllidea)	<i>Railietina celebensis</i> (Janicki, 1902)	Small intestine



Table 1 (continuation)

	"	Ofektaman (Telefomin valley)	Cestoda (Cyclophyllidea)	<i>Raillietina</i> s. l.	Small intestine
	"	Ofektaman (Telefomin valley)	Cestoda (Cyclophyllidea)	<i>Rodentolepis fraterna</i> (Stiles, 1906)	Small intestine
	"	near Ok Tedi Mine, Ofektaman (Telefomin valley),	Nematoda (Strongylida)	<i>Mawsonema mokwanensis</i> Smales et Heinrich, 2010	Small intestine
	"	Star Mountains (Dokfuma)	Nematoda (Strongylida)	<i>Montistrongylus ingati</i> Smales et Heinrich, 2010	Small intestine
	"	Tifalmin, Finimter, Ofektaman (Telefomin Valley)	Nematoda (Strongylida)	<i>Hughjonestrongylus ennisae</i> (Smales et Heinrich, 2010)	Small intestine
	"	Finimter, Tifalmin, near Feramin, two sites in Telefomin area	Nematoda (Strongylida)	<i>Parasabanema szalay</i> Smales et Heinrich, 2010	Small intestine
	"	Dokfuma, Tifalmin, Ofektaman (Telefomin valley)	Nematoda (Spirurida)	<i>Protospirura kaindiensis</i> Smales, 2001b	Stomach
	"	Tifalmin	Nematoda (Strongylida)	<i>Paraustrostrongylus paramelomysi</i> Smales et Heinrich, 2010	Small intestine
	"	Mabiomskin (near Ok Tedi Mine)	Nematoda (Ascaridida)	Nippostrongylinae: species not identified	Small intestine
	"	Bafunmin	Nematoda (Oxyurida)	<i>Syphacia longaecausta</i> Smales, 2001a	Caecum/colon
	"	Bafunmin	Insecta (Siphonaptera)	<i>Parastivalius chelaformis</i> Hastreiter, 2014	Body surface
	"	Bafunmin	Insecta (Siphonaptera)	<i>Parastivalius novaeguineae</i> (Rothschild, 1934)	Body surface
	"	Telefomin, Bafunmin	Insecta (Siphonaptera)	<i>Rectidigitus spooneri</i> Rothschild, 1934	Body surface
	"	Telefomin, Bafunmin	Insecta (Siphonaptera)	<i>Rectidigitus szentivanyi</i> Holland, 1969	Body surface
	"	Bafunmin	Insecta (Siphonaptera)	<i>Rectidigitus traubi</i> Holland, 1969	Body surface
	"	Bafunmin	Insecta (Siphonaptera)	<i>Traubia</i> (T.) <i>durdeni</i> Hastreiter, 2015	Body surface
	"	N.E. & N.W. of Telefomin	Insecta (Siphonaptera)	<i>Traubia</i> (<i>Kuruopsylla</i>) <i>kuru</i> Holland, 1969	Body surface
	"	Telefomin, Tifalmin	Acari (Ixodida)	<i>Ixodes priscicollaris</i> Schulze, 1932	Body surface
	Mountain Paramelomys or Mountain Mosaic-tailed Rat <i>Paramelomys</i> cf. <i>rubex</i> (Thomas, 1922a)	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla bisinuata</i> Holland, 1969	Body surface
	"	Telefomin, Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	"	Bafunmin, Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Acanthopsylla eudromiciae</i> Holland, 1969	Body surface
	"	Star Mountains	Insecta (Siphonaptera)	<i>Acanthopsylla richardsoni</i> Smit, 1953	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Orthopsylla</i> (<i>O.</i>) <i>uncinata</i> Hastreiter, 2014	Body surface
	"	Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Striopsylla mercurius</i> Mardon, 1978	Body surface
	"	Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Striopsylla vandeuseni</i> Holland, 1969	Body surface
	<i>Paramelomys</i> sp.	Telefomin	Insecta (Siphonaptera)	<i>Wilsonipsylla spinicoxa</i> Hastreiter, 2012	Body surface
	Shaw Mayer's Pogonomelomys <i>Pogonomelomys mayeri</i> (Rothschild et Dollman, 1932)	Star Mountains	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	Champion's Tree-mouse <i>Pogonomys championi</i> Flannery, 1988	Tifalmin	Cestoda (Cyclophyllidea)	<i>Bertiella musasabi</i> Yamaguti, 1942	Small intestine
	"	Tifalmin	Nematoda (Ascaridida)	<i>Subulura andersoni</i> (Cobbold, 1876)	Caecum
	"	Ofektaman (Telefomin valley)	Nematoda (Strongylida)	<i>Bunomystrostrongylus ilami</i> Smales, 2015	Small intestine
	"	Tifalmin, Ofektaman (Telefomin valley)	Nematoda (Strongylida)	<i>Hasanuddinia pogonomyos</i> Smales, 2014	Small intestine
	"	Ofektaman (Telefomin valley)	Nematoda (Strongylida)	Nippostrongylinae: species not identified	Small intestine



Table 1 (continuation)

	"	Tifalmin, Ofektaman (Telefomin valley)	Nematoda (Enoplida)	<i>Trichuris germani</i> Smales, 2013	Caecum
	Chestnut Tree-mouse <i>Pogonomys macrourus</i> (Milne-Edwards, 1877)	Telefomin	Insecta (Siphonaptera)	<i>Orthopsylloides</i> (O.) <i>uncinata</i> Hastriter, 2014	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Rectidigitus traubi</i> Holland, 1969	Body surface
	Gray-bellied Tree-mouse <i>Pogonomys sylvestris</i> Thomas, 1920	Bafunmin	Nematoda (Ascaridida)	<i>Heterakis</i> sp.	Large intestine
	"	Bafunmin	Nematoda (Strongylida)	<i>Odilia whittingtoni</i> Smales, 2015	Small intestine
	"	Bafunmin	Insecta (Siphonaptera)	<i>Rectidigitus traubi</i> Holland, 1969	Body surface
	Black-tailed Giant-rat <i>Uromys anak</i> Thomas, 1907	Tifalmin	Nematoda (Strongylida)	<i>Nippostrongylus sembeli</i> Hasegawa et Tarore, 1995	Small intestine
	"	Tifalmin	Nematoda (Strongylida)	<i>Odilia carinatae</i> Smales, 2008 [Nippostryngylinae incertae sedis acc. to Durette-Desset & Digiani, 2015]	Small intestine
	"	Tifalmin	Nematoda (Strongylida)	<i>Hughjonestrongylus implexus</i> (Smales, 2008)	Small intestine
	"	Tifalmin	Nematoda (Strongylida)	<i>Odilia melomyos</i> (Mawson, 1961)	Small intestine
	"	Tifalmin	Nematoda (Strongylida)	<i>Odilia uromyos</i> (Mawson, 1961) [Nippostrongylinae incertae sedis acc. to Durette-Desset & Digiani, 2015]	Small intestine
	"	Tifalmin	Nematoda (Strongylida)	<i>Pithecostrongylus anak</i> Smales, 2007	Small intestine
	"	Tifalmin	Nematoda (Ascaridida)	<i>Subulura andersoni</i> (Cobbold, 1876)	Caecum
	"	Tifalmin	Nematoda (Oxyurida)	<i>Syphacia longaecausta</i> Smales, 2001a	Caecum
	Mottled-tailed Giant-rat <i>Uromys caudimaculatus</i> (Krefft, Siphonaptera)	Star Mountains	Nematoda (Ascaridida)	<i>Subulura andersoni</i> (Cobbold, 1876)	Caecum
	"	Tifalmin	Nematoda (Strongylida)	<i>Odilia carinatae</i> Smales, 2008 [Nippostryngylinae incertae sedis acc. to Durette-Desset & Digiani, 2015]	Small intestine
	"	Tifalmin	Nematoda (Strongylida)	<i>Hughjonestrongylus implexus</i> (Smales, 2008)	Small intestine
	"	Telefomin, Bafunmin	Insecta (Siphonoptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	"	Bafunmin	Insecta (Siphonoptera)	<i>Orthopsylloides</i> (O.) <i>uncinata</i> Hastriter, 2014	Body surface
Mammals (rodents, Muridae Murini)	House Mouse <i>Mus musculus</i> Linnaeus, 1758	Telefomin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
Mammals (rodents, Muridae Rattini)	Cape York Rat <i>Rattus leucopus</i> (Gray, Siphonaptera)	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	<i>Hymenolepis diminuta</i> (Rudolphi, 1819)	Small intestine
	"	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	<i>Raillietina</i> (R.) sp.	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Ascaridida)	<i>Heterakis spumosa</i> (Schneider, 1866)	Caecum
	"	Bula Plain/Bensbach	Nematoda (Ascaridida)	<i>Subulura andersoni</i> (Cobbold, 1876)	Large intestine
	"	Bula Plain/Bensbach	Nematoda (Enoplida)	<i>Trichuris muris</i> (Schrank, 1788)	Caecum
	"	Bula Plain/Bensbach	Acanthocephala	Species not identified	Small intestine
	"	Bula Plain/Bensbach	Insecta (Siphonaptera)	<i>Xenopsylla vexabilis</i> Jordan, 1925	Body surface
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Laelaps sedlaceki</i> Strandtmann et Mitchell, 1963	Body surface
	Moss-forest Rat <i>Rattus niobe</i> (Thomas, 1906)	Tifalmin, Dokfuma, Ofektaman (Telefomin valley), Kamptamen (S of Hindenburg Wall)	Cestoda (Cyclophyllidea)	<i>Hymenolepis</i> cf. <i>diminuta</i> (Rudolphi, 1819)	Small intestine
	"	Dokfuma	Cestoda (Cyclophyllidea)	<i>Mathevotaenia niuguiniensis</i> Beveridge, 2008	Small intestine
	"	Tifalmin, Ofektaman (Telefomin valley),	Cestoda (Cyclophyllidea)	Dilepididae: species not identified	Small intestine



Table 1 (continuation)

	"	Dokfuma, Tifalmin	Nematoda (Enoplida)	<i>Eucoleus</i> sp.	Small intestine
	"	Tifalmin	Nematoda (Enoplida)	<i>Trichuris muris</i> (Schrunk, 1788)	Caecum
	"	Ofektaman (Telefomin valley)	Nematoda (Ascaridida)	<i>Toxocara mackerrasae</i> (Sprent, 1957)	Stomach
	"	Dokfuma, Tifalmin, Ofektaman (Telefomin valley), Ok Tedi Mine	Nematoda (Ascaridida)	<i>Heterakis sirawii</i> Smales, 2016b	Caecum
	"	Ofektaman (Telefomin valley)	Nematoda (Strongylida)	<i>Nugininema titokis</i> Smales, 2016a	Small intestine
	"	Tifalmin	Nematoda (Strongylida)	<i>Rodentanema aenigma</i> Smales, 2016a	Small intestine
	"	Dokfuma, Tifalmin, Ofektaman (Telefomin valley)	Nematoda (Strongylida)	Nippostrongylinae: species not identified	Small intestine
	"	Dokfuma, Ofektaman (Telefomin valley), Kamptamen (s. of Hindenburg Wall)	Nematoda	Juveniles not identified	Caecum
	"	Dokfuma, Tifalmin, Ofektaman (Telefomin valley), s. of Hindenburg Wall, Ok Tedi Mine	Nematoda (Oxyurida)	<i>Syphacia</i> (S.) <i>niobe</i> Smales, 2016a	Caecum
	"	Dokfuma, Tifalmin, Ofektaman (Telefomin valley)	Nematoda (Spirurida)	<i>Protospirura kainiensis</i> Smales, 2001b	Stomach
	"	Dokfuma	Nematoda (Spirurida)	<i>Protospirura muricola</i> Geddelst, 1916	Stomach
	"	Mabiomskin (near Ok Tedi Mine)	Acanthocephala (Echinorhynchida)	<i>Moniliformis moniliformis</i> (Bremser, 1811 in Rudolphi, 1819)	Small intestine
	"	Star Mountains, Telefomin	Insecta (Siphonaptera)	<i>Rectidigitus glomerospinosus</i> Hastriter, 2016	Body surface
	"	Telefomin, Bafunmin	Insecta (Siphonaptera)	<i>Rectidigitus spooneri</i> Rothschild, 1934	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Rectidigitus szentivanyi</i> Holland, 1969	Body surface
	"	Telefomin, Bafunmin	Insecta (Siphonaptera)	<i>Rectidigitus traubi</i> Holland, 1969	Body surface
	"	Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Traubia</i> (T.) <i>durdeni</i> Hastriter, 2015	Body surface
	"	Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Traubia</i> (T.) <i>egregia</i> Smit, 1953	Body surface
	"	Telefomin	Acari (Ixodida)	<i>Ixodes priscicollaris</i> Schulze, 1932	Body surface
	Moss-forest Rat <i>Rattus</i> cf. <i>niobe</i> (Thomas, 1906)	Telefomin, Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla bisinuata</i> Holland, 1969	Body surface
	"	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	"	Lake Louise (Telefomin area), Bafunmin, Star Mountains	Insecta (Siphonaptera)	<i>Acanthopsylla eudromiciae</i> Holland, 1969	Body surface
	"	Lake Louise (Telefomin area), Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla richardsoni</i> Smit, 1953	Body surface
	"	Lake Louise (Telefomin area), Star Mountains	Insecta (Siphonaptera)	<i>Striopsylla bifurcata</i> Hastriter et Easton, 2013	Body surface
	"	Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Striopsylla vandeuseni</i> Holland, 1969	Body surface
	Small Spiny Rat <i>Rattus steini</i> Rümmler, 1935	Bafunmin	Nematoda (Enoplida)	<i>Capillaria</i> s. l.	Stomach
	"	Telefomin, Feramin	Nematoda (Enoplida)	<i>Eucoleus</i> sp.	Small intestine
	"	Telefomin, Bafunmin, Feramin	Nematoda (Ascaridida)	<i>Heterakis spumosas</i> (Schneider, 1866)	Caecum
	"	Bafunmin	Nematoda (Ascaridida)	<i>Subulura</i> sp.	Caecum
	"	Telefomin, Bafunmin	Nematoda (Ascaridida)	<i>Toxocara mackerrasae</i> (Sprent, 1957)	Stomach
	"	Telefomin, Bafunmin	Nematoda (Strongylida)	<i>Cyclodontostomum purvisi</i> Adams, 1933	Caecum
	"	Telefomin, Bafunmin, Feramin	Nematoda (Strongylida)	Nippostrongylinae species 1 & 2 not identified	Small intestine



Table 1 (continuation)

	"	Bafunmin	Nematoda (Strongylida)	Unidentified heligmonellid	Small intestine
	"	Telefomin, Bafunmin,	Nematoda (Oxyurida)	<i>Syphacia australasiensis</i> Smales, 2004	Caecum
	"	Telefomin, Bafunmin, Feramin	Nematoda (Spirurida)	<i>Mastophorus muris</i> (Gmelin, 1790)	Stomach
	"	Bafunmin	Nematoda (Spirurida)	<i>Protospirura kaindiensis</i> Smales, 2001b	Stomach
	"	Bafunmin	Acanthocephala (Echinorhynchida)	<i>Moniliformis</i> sp.	Small intestine
	"	Telefomin, Feramin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	"	Telefomin, Bafunmin	Insecta (Siphonaptera)	<i>Orthopsyllodes</i> (O.) <i>uncinata</i> Hastriter, 2014	Body surface
	"	Telefomin, Feramin	Acari (Ixodida)	<i>Ixodes priscicollaris</i> Schulze, 1932	Body surface
	New Guinea Slender Rat <i>Rattus</i> (<i>Stenomys</i>) <i>verecundus</i> (Thomas, 1904b)	Bafunmin	Nematoda (Enoplida)	<i>Capillaria</i> s. l.	Duodenum
		Bafunmin, Mt. Fubilan (Ok Tedi)	Nematoda (Ascaridida)	<i>Heterakis spumosa</i> (Schneider, 1866)	Caecum
	"	Mt. Fubilan (Ok Tedi)	Nematoda (Ascaridida)	<i>Subulura andersoni</i> (Cobbold, 1876)	Caecum
	"	Mt. Fubilan (Ok Tedi)	Nematoda (Spirurida)	<i>Protospirura kaindiensis</i> Smales, 2001b	Stomach
	"	Bafunmin	Nematoda (Strongylida)	<i>Missimstrongylus oweni</i> Smales, 2018	Small intestine
	"	Mt. Fubilan (Ok Tedi)	Nematoda	Species not identified	Caecum
	"	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla bisinuata</i> Holland, 1969	Body surface
	"	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	Rat <i>Rattus</i> sp.	Bula Plain/Bensbach	Nematoda (Oxyurida)	<i>Syphacia</i> sp.	Caecum/rectum
	"	Bula Plain/Bensbach	Nematoda (Enoplida)	<i>Trichuris muris</i> (Schrank, 1788)	Caecum
	"	Bula Plain/Bensbach	Nematoda	Species not identified	Small intestine
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Hoplopleura pacifica</i> Ewing, 1924	Body surface
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Laelaps sedlaceki</i> Strandtmann et Mitchell, 1963	Body surface
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Laelaps nuttalli</i> Hirst, 1915	Body surface
Mammals (marsupials, Dasyuridae)	New Guinea Quoll <i>Dasyurus albopunctatus</i> Schlegel, 1880	Bula Plain/Bensbach	Protozoa (Piroplasmorida)	<i>Sarcocystis</i> sp.	Musculature
	"	Star Mountains	Insecta (Siphonaptera)	<i>Acanthopsylla richardsoni</i> Smit, 1953	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Rectidigitus szentivanyi</i> Holland, 1969	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Rectidigitus traubi</i> Holland, 1969	Body surface
	Habbema Dasyure <i>Micromurexia habbema</i> (Tate et Archbold, 1941)	Star Mountains	Insecta (Siphonaptera)	<i>Acanthopsylla richardsoni</i> Smit, 1953	Body surface
	Short-furred Dasyure <i>Murexia longicaudata</i> (Schlegel, 1866)	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	Speckled Dasyure <i>Neophascogale lorentzii</i> (Jentink, 1911b)	Bafunmin	Insecta (Siphonaptera)	<i>Rectidigitus spooneri</i> Rothschild, 1934	Body surface
	Narrow-striped Dasyure <i>Phascolosorex dorsalis brevicaudata</i> (Rothschild et Dollman, 1932)	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	Red-cheeked Dunnart <i>Sminthopsis virginiae</i> (Tarragon, 1847)	Bula Plain/Bensbach	Protozoa (Piroplasmorida)	<i>Sarcocystis</i> sp.	Musculature
	"	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	<i>Hymenolepis</i> sp. nov.	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Mackerrastrongylus</i> sp.	Stomach
	"	Bula Plain/Bensbach	Nematoda	Species not identified	Stomach, small intestine



Table 1 (continuation)

	Dunnart <i>Sminthopsis</i> sp.	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	taenid sp. not identified	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Patricialina</i> spp.	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	? <i>Mackerrastrongylus</i> sp.	Small intestine
Mammals (marsupials, Peroryctidae)	Common Spiny Bandicoot <i>Echymipera kalubu</i> (Fischer, 1829)	Bula Plain/Bensbach	Nematoda (Ascaridida)	<i>Heterakis spumosa</i> Schneider, 1866	Large intestine
	"	Weam	Nematoda (Ascaridida)	<i>Linstowenema warringtoni</i> Smales, 1997	Small intestine
	"	Weam	Nematoda (Strongylida)	<i>Mackerrastrongylus peramelis</i> (Johnston et Mawson, 1938)	Small intestine
	"	Weam	Nematoda (Strongylida)	<i>Peramelistrongylus skedastos</i> Mawson, 1960	Stomach
	"	Weam	Nematoda	Species not identified	Small intestine
	"	Bula Plain/Bensbach	Acanthocephala	Species not identified	Small intestine
	"	Weam	Acari (Ixodida)	Species not identified	Body surface
	"	Weam	Acari (Mesostigmata)	Species not identified	Body surface
	Bandicoot <i>Echymipera</i> sp.	Bafunmin	Insecta (Siphonaptera)	<i>Parastivalius novaeguineae</i> (Rothschild, 1904)	Body surface
	Striped Bandicoot <i>Microperoryctes longicauda</i> (Peters et Doria, 1876)	Telefomin, Bafunmin)	Insecta (Siphonaptera)	<i>Parastivalius chelaformis</i> Has-triter, 2014	Body surface
	"	Star Mountains	Insecta (Siphonaptera)	<i>Rectidigitus spooneri</i> Rothschild, 1934	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Restidigitus szentivanyi</i> Holland, 1969	Body surface
	"	Telefomin, Bafunmin	Insecta (Siphonaptera)	<i>Rectidigitus traubi</i> Holland, 1969	Body surface
	"	Star Mountains	Insecta (Siphonaptera)	<i>Striopsylla bifurcata</i> Has-triter et Easton, 2013	Body surface
	"	Bafunmin, Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Striopsylla vandeuseni</i> Holland, 1969	Body surface
	"	Star Mountains	Insecta (Siphonaptera)	<i>Traubia (T.) egregia</i> Smit, 1953	Body surface
	"	Bafunmin, Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Traubia (Kuruopsylla) kuru</i> Holland, 1969	Body surface
	Bandicoot <i>Microperoryctes</i> sp.	Star Mountains	Insecta (Siphonaptera)	<i>Striopsylla mercurius</i> Mardon, 1978	Body surface
	Raffray's Bandicoot <i>Peroryctes raffrayana</i> (Milne-Edwards, 1878)	Telefomin	Insecta (Siphonaptera)	<i>Parastivalius papillatus</i> Has-triter, 2014	Body surface
	"	Lake Louise (Telefomin area)	Insecta (Siphonaptera)	<i>Striopsylla vandeuseni</i> Holland, 1969	Body surface
	Bandicoot "Peroryctes" sp.	Bafunmin	Insecta (Siphonaptera)	<i>Striopsylla vandeuseni</i> Holland, 1969	Body surface
	'Bandicoot'	Bula Plain/Bensbach	Protozoa (Piroplasmorida)	<i>Sarcocystis</i> sp.	Musculature
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Haemaphysalis humerosa</i> Warburton et Nuttall, 1909	Body surface
Mammals (marsupials, Peramelidae)	Northern Brown Bandicoot <i>Isodon macrourus</i> (Gould, 1842a)	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	<i>Paralinstowia semoni</i> (Zschokke, 1896)	Small intestine
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Boopia bettongia</i> Le Souëf et Bullen, 1902	Body surface
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Haemaphysalis bancrofti</i> Nuttall et Warburton, 1915	Body surface
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Haemaphysalis humerosa</i> Warburton & Nuttall, 1909	Body surface
Mammals (marsupials, Macropodidae)	Gray Dorcopsis <i>Dorcopsis luctuosa</i> (D'Albertis, 1874)	Middle Strickland River area	Nematoda (Strongylida)	<i>Labiostrongylus redmondi</i> Smales, 1982b	Stomach
	"	Middle Strickland River area	Nematoda (Strongylida)	<i>Paralabiostrongylus bicollaris</i> Smales, 1982b	Stomach
	"	Middle Strickland River area	Nematoda (Strongylida)	<i>Dorcopsinema dorcopsis</i> (Baylis, 1940)	Stomach
	"	Middle Strickland River area	Nematoda (Strongylida)	<i>Dorcopsisstrongylus labiacarinatus</i> Smales, 1982a	Stomach
	Agile Wallaby <i>Macropus agilis</i> (Gould, 1841)	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Gemellitocotyle wallabicola</i> Prudhoe, 1975	Fore stomach
	"	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Macropotrema pertinax</i> Blair, Beveridge, Speare, 1979	Caecum



Table 1 (continuation)

	"	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	<i>Progamotaenia fellicola</i> (Nybelin, 1917)	Gall bladder, bile ducts
	"	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	<i>Progamotaenia proterogyna</i> (Fuhrmann, 1933)	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Beveridgea corneri</i> Mawson, 1980	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Cloacina cornuta</i> (Davey et Wood, 1938)	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Cloacina oweni</i> Beveridge, 2002a	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Cloacina papuensis</i> Beveridge, 2002a	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Filarinema mawsonae</i> Cassone et Baccam, 1985	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Globocephaloides macropodis</i> Yorke et Maplestone, 1926	Duodenum
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Hypodontus macropi</i> Mönning, 1929	Large intestine, caecum
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Labiostrongylus</i> (L.) <i>labiostrongylus</i> Yorke et Maplestone, 1926	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Macropostrongylus yorkei</i> Baylis, 1927	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Pharyngostrongylus macropodis</i> Yorke et Maplestone, 1926	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Popovastrongylus macropodis</i> Beveridge, 1986	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Spirostrongylus spirostrongylus</i> Yorke et Maplestone, 1926	Oesophagus
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Woodwardostrongylus oben-dorfi</i> Mawson, 1976	Stomach
	"	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Breinlia</i> (B.) <i>boltoni</i> (Spratt et Varughese, 1975)	Body cavities
	"	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Breinlia</i> (B.) <i>robertsi</i> Johnston et Mawson, 1938	Thoracic cavity
	"	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Breinlia</i> (B.) sp.	Thoracic cavity
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Heterodoxus spiniger</i> (Enderlein, 1909)	Body surface
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Heterodoxus</i> sp.	Body surface
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	Species not identified	Body surface
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Haemaphysalis bancrofti</i> Nuttall et Warburton, 1915	Body surface
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Laelaps sedlaceki</i> Strandmann et Mitchell, 1963	Body surface
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	<i>Alliphis</i> sp.	Body surface
	"	Bula Plain/Bensbach	Acari (Trombidiformes)	<i>Eutrombicula</i> sp. (larvae)	Body surface
	"	Bula Plain/Bensbach	Coleoptera (Scarabaeidae)	<i>Onthophagus parvus</i> Blanchard, 1853	Temporarily attached to fur around cloacal opening
	"	Bula Plain/Bensbach	Coleoptera (Scarabaeidae)	<i>Onthophagus symbioticus</i> Arrow, 1920	Temporarily attached to fur around cloacal opening
	Red-legged Pademelon <i>Thylogale stigmatica orio</i> (Tate et Archbold, 1935b)	Bula Plain/Bensbach	Protozoa (Piroplasmorida)	<i>Sarcocystis</i> sp.	Musculature
	"	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	<i>Calostaurus macropus</i> (Ortlepp, 1922)	Small intestine
	"	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	<i>Progamotaenia queenslandensis</i> Beveridge, 1985	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Amphicephaloides thylogale</i> Beveridge, 1979	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Cloacina cloelia</i> Beveridge, 1998	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Cloelia cybele</i> Beveridge, 1998	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Cloelia dahl</i> (Linstow, 1898)	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Coronostrongylus johnsoni</i> Beveridge, 2002b	Stomach



Table 1 (continuation)

	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Foliostoma macropodis</i> Beveridge et Johnson, 1981	Oesophagus
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	Macropostrongylinae: genus not identified	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Monilonema lacunosum</i> Beveridge et Johnson, 1981	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Pharyngostrongylus thylogale</i> Beveridge, 2016	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Pharyngostrongylus setosus</i> Beveridge, 1982	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Popovastrongylus thylogale</i> Beveridge, 1986	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Rugopharynx sigma</i> Chilton, Beveridge et Andrews, 1993	Stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Sutorostrongylus johnsoni</i> Beveridge et Durette-Desset, 2004	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Thallostoma lichtenfelsi</i> Beveridge, 1983	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Thylonema arundeli</i> Beveridge, 1981b	Oesophagus, stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Thylonema barkeri</i> Beveridge, 1981b	Oesophagus, stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Thylonema thylonema</i> Beveridge, 1981b	Oesophagus, stomach
	"	Bula Plain/Bensbach	Nematoda (Strongylida)	<i>Trigonostoma trigonostomum</i> Beveridge, 1981a	Oesophagus, stomach
	"	Bula Plain/Bensbach	Nematoda (Oxyurida)	<i>Macropoxyuris</i> sp.	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Oxyurida)	oxyuroid larvae	Small intestine
Mammals (marsupials, Phalangeridae)	Southern Common Cuscus <i>Phalanger mimicus</i> (Thomas, 1922b)	Baiyer River Sanctuary ex Western Province	Nematoda (Enoplida)	<i>Trichuris</i> sp.	Caecum
	Stein's Cuscus <i>Phalanger vestitus</i> (Milne-Edwards, 1877)	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
Mammals (marsupials, Burramyidae)	Long-tailed Pigmy Possum <i>Cercartetus caudatus</i> (Milne-Edwards, 1877)	Feramin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
Mammals (marsupials, Petauridae)	Great-tailed Triok <i>Dactylopsila megalura</i> Rothschild et Dollman, 1932	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	Striped Possum <i>Dactylopsila trivirgata</i> J. E. Gray, 1858	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Breinlia</i> (B.) <i>oweni</i> Spratt, 2011	Thoracic & abdominal cavities
	"	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Pseudophysaloptera enigmatica</i> Bennett, 2003	Stomach
	Possum <i>Dactylopsila</i> sp.	Bula Plain/Bensbach	Protozoa (Piroplasmorida)	<i>Sarcocystis</i> sp.	Musculature
	Sugar Glider <i>Petaurus breviceps</i> Waterhouse, 1838	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	"	Telefomin	Insecta (Siphonaptera)	<i>Parastivalius chelaformis</i> Haster, 2014	Body surface
	"	Feramin	Insecta (Siphonaptera)	<i>Traubia</i> (<i>Kuruopsylla</i>) <i>kuru</i> Holland, 1969	Body surface
Mammals (marsupials, Pseudocheiridae)	Painted Ringtail <i>Pseudocheirus forbesi</i> (Thomas, 1887)	Bafunmin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
	Pygmy Ringtail <i>Pseudocheirus mayeri</i> (Rothschild et Dollman, 1932)	Telefomin	Insecta (Siphonaptera)	<i>Acanthopsylla enderleini</i> (Wagner, 1933)	Body surface
Birds (Casuariiformes)	Southern Cassowary <i>Casuarius casuarius</i> (Linnaeus, 1758)	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Habronema casuarii</i> Mapleson, 1932	Stomach wall & mucosa
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Therodoxus oweni</i> Clay, 1971	Body surface of thighs
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Amblyomma papuanum</i> Hirst, 1914	Body surface
	"	Balimo	Acari (Sarcoptiformes)	<i>Sarcoptes scabiei</i> (Linnaeus, 1758)	Skin of head & neck



Table 1 (continuation)

Birds (Galliformes)	Domestic Chicken <i>Gallus gallus</i> (Linnaeus, 1758)	Village near Kiunga	Trematoda (Digenea)	<i>Prosthogonimus ovatus</i> (Rudolphi, 1803)	Oviducts, bursa
	"	Village near Kiunga	Cestoda (Cyclophyllidea)	<i>Amoebotaenia cuneata</i> (Lin-stow, 1872)	Small intestine
	"	Village near Kiunga	Cestoda (Cyclophyllidea)	<i>Hymenolepis exigua</i> Yoshida, 1910	Small intestine
	"	Village near Kiunga	Cestoda (Cyclophyllidea)	<i>Hymenolepis</i> s. l., sp. n.	Small intestine
	"	Village near Kiunga	Cestoda (Cyclophyllidea)	<i>Raillietina</i> (R.) <i>echinobothrida</i> (Megnin, 1881)	Small intestine
	"	Balimo	Nematoda (Enoplida)	<i>Capillaria</i> sp.	Small intestine
	"	Balimo	Nematoda (Ascaridida)	<i>Heterakis gallinarum</i> (Schrank, 1788)	Caeca
	"	Village near Kiunga	Nematoda (Spirurida)	<i>Oxyspirura mansonii</i> (Cobbold, 1879)	Under eyelids
	"	Village near Kiunga	Nematoda (Strongylida)	<i>Trichostongylus tenuis</i> (Mehlis in Creplin, 1846)	Small intestine
	"	Village near Kiunga	Acanthocephala (Gigantorhynchida)	<i>Mediorhynchus gallinarum</i> (Bhalara, 1937)	Small intestine
	"	Village near Kiunga	Insecta (Phthiraptera)	<i>Menopon gallinae</i> (Linnaeus, 1758)	Feathers
	"	Village near Kiunga	Insecta (Phthiraptera)	<i>Cuclotogaster heterographus</i> (Nitzsch in Giebel, 1866)	Head feathers
	"	Kavianunga	Acari (Sarcoptiformes)	<i>Knemidokoptes mutans</i> (Robin et Languetin, 1859)	Legs
	Orange-footed Scrub-fowl <i>Megapodius reinwardt reinwardt</i> Dumont, 1823	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	<i>Megacirrus leptophallus</i> (Kotlán, 1923)	Small intestine
	"	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	'dilepid' ? gen. n., sp. n.	Small intestine
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Goniodes major</i> (Piaget, 1880)	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Goniodes minor</i> (Piaget, 1880)	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Lipeurus latifasciatus</i> Piaget, 1890b	Feathers
	Yellow-legged Brush-turkey <i>Talegalla</i> cf. <i>fuscirostris</i> Salvadori, 1877	Bula Plain/Bensbach	Acari (Ixodida)	<i>Amblyomma papuanum</i> Hirst, 1914	Body surface
Birds (Anseriformes)	Magpie Goose <i>Anseranas semipalmata</i> (Latham, 1798)	Bula Plain/Bensbach	Insecta Phthiraptera)	<i>Acidoproctus hillii</i> (Harrison, 1915)	Underside of wing feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Holomenopon goliath</i> Clay, 1961	Underside of wing feathers
	Wandering Whistling Duck <i>Dendrocygna arcuata australis</i> (Reichenbach, 1850)	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Apatemon</i> sp.	Small intestine
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Acidoproctus emersoni</i> Timmerman, 1962	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Holomenopon leucoanthum</i> (Burmeister, 1838)	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Trinoton laveryi</i> Clay, 1963	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	Species not identified	Feathers
	Raja Shelduck <i>Tadorna radjah</i> (Lesson, 1828)	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Apatemon</i> (A.) <i>gracilis</i> (Rudolphi, 1819)	Small intestine
	"	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Echinostoma</i> sp.	Small intestine
	"	Bula Plain/Bensbach	Acanthocephala (Echinorhynchida)	<i>Polymorphus</i> sp. near <i>marilis</i> Van Cleave, 1939	Small intestine
	"	Bula Plain/Bensbach	Insecta Phthiraptera)	<i>Anaticola</i> sp.	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Holomenopon obscurum</i> (Piaget, 1880)	Feathers
Birds (Columbiformes)	Pinon's Imperial Pigeon <i>Ducula pinon</i> (Quoy et Gaimard, 1824)	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Tetrameres</i> sp.	Proventriculus
	Torresian Imperial Pigeon <i>Ducula spilorrhoa</i> (G. R. Gray, 1858)	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Brachylecithum</i> sp.	Small intestine



Table 1 (continuation)

	"	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Skrjabinus</i> sp.	Small intestine
	Black-billed Cuckoo-Dove <i>Macropygia nigrirostris</i> Salvadori, 1875a	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Coloceras</i> spp.	Feathers
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	Species not identified	Feathers
	Orange-fronted Fruit-Dove <i>Ptilinopus aurentifrons</i> G. R. Gray, 1858	Bula Plain/Bensbach	Insecta (Phthiraptera)	Species not identified	Feathers
	Pink-spotted Fruit-Dove <i>Ptilinopus perlatus zonurus</i> (Salvadori, 1876)	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Ceratospira</i> ?sp. n.	Under eyelids
Birds (Ciconiiformes)	Little Pied Cormorant <i>Microcarbo melanoleucos</i> (Vieillot, 1817)	Bula Plain/Bensbach	Nematoda (Ascaridida)	<i>Contracaecum spiculigerum</i> (Rudolphi, 1809)	Intestine
	Australian Pelican <i>Pelecanus conspicillatus</i> Temminck, 1824	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Bolbophorus confusus</i> (Krause, 1914)	? Gizzard
	"	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Mesostephanus</i> sp. prob. <i>pelecani</i> Cribb, Barker et Beuret, 1995	Small intestine
	"	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Renicola</i> sp.	Kidney
	"	Bula Plain/Bensbach	Nematoda (Ascaridida)	<i>Contracaecum micropapillatum</i> (Stossich, 1890)	Gizzard
	Australian White Ibis <i>Threskiornis molucca</i> (Cuvier, 1829)	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Nephrostomum</i> sp.	Small intestine
	"	Bula Plain/Bensbach	Trematoda (Digenea)	<i>Parastrigea</i> sp.	Duodenum
	"	Bula Plain/Bensbach	Cestoda (Cyclophyllidae)	<i>Paradilepis</i> sp.	Duodenum
	"	Bula Plain/Bensbach	Acanthocephala	gen. n., sp. nov.	Small intestine
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Ardeicola ibis</i> Le Souëf & Bullen, 1902	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Colpocephalum aethiopicae</i> Price & Beer, 1965	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Ibidoecus diana</i> Tandan, 1958	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Plegadiphilus threskiornis</i> Bedford, 1939	Feathers
	"	Bula Plain/Bensbach	Insecta (Diptera)	<i>Icostia</i> (<i>Ardmoeca</i>) sp. 'N' Maa, 1969	Body surface
Birds (Charadriiformes)	Brown Noddy <i>Anous stolidus</i> (Linnaeus, 1758)	Bula Plain/Bensbach	Nematoda (Ascaridida)	<i>Contracaecum variegatum</i> (Rudolphi, 1809)	Proventriculus
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Actornithophilus incisus</i> (Piaget, 1880)	Feathers
	Sharp-tailed Sandpiper <i>Calidris acuminata</i> (Horsfield, 1821)	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Actornithophilus umbrinus</i> (Burmeister, 1838)	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Carduiceps zonarius</i> (Nitzsch, 1866)	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Luniceps incoenis</i> (Kellogg et Chapman, 1899)	Feathers
	Curlew Sandpiper <i>Calidris ferruginea</i> (Pontoppidan, 1763)	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Actornithophilus umbrinus</i> (Burmeister, 1838)	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Carduiceps</i> sp.	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Luniceps</i> sp.	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Saemondssonina</i> (S.) sp.	Feathers
	Red-necked Stint <i>Calidris ruficollis</i> (Pallas, 1776)	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Actornithophilus umbrinus</i> (Burmeister, 1838)	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Carduiceps zonarius</i> (Nitzsch, 1866)	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Saemondssonina</i> (S.) sp.	Feathers



Table 1 (continuation)

	Oriental Plover <i>Charadrius veredus</i> Gould, 1848	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Quadriiceps assimilis</i> (Piaget, 1890a)	Feathers
	Whiskered Tern <i>Chlidonias hybrida</i> <i>javanicus</i> (Horsfield, 1821)	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Quadriiceps anagrapsus</i> (Nitzsch in Giebel, 1866)	Feathers
	"	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Saemondssonina</i> (S.) <i>lobaticeps</i> (Giebel, 1874)	Feathers
	Beach Stone-curlew <i>Esacus magnorostris</i> (Vieillot, 1818b)	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Quadriiceps</i> sp. near <i>annulatus</i> (Denny, 1842)	Feathers
	Black-winged Stilt <i>Himantopus himanto- pus</i> (Linnaeus, 1758)	Bula Plain/Bens- bach	Cestoda (Cyclophyllidea)	<i>Gyrocoelia crassa</i> (Fuhrmann, 1900)	Duodenum
	"	Bula Plain/Bens- bach	Cestoda (Cyclophyllidea)	<i>Wardium tsengi</i> (Joyeux et Baer, 1940)	Small intestine
	Little Curlew <i>Numenius minutus</i> Gould, 1840	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Austromenopon</i> sp. (nymphs)	Feathers
	"	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Luniceps</i> sp.	Feathers
	"	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Saemondssonina</i> (S.) <i>scolopaci- sphaeopodis</i> (Schrank, 1803) group	Feathers
Birds (Accipitri- formes)	Whistling Kite <i>Haliastur sphenurus</i> (Vieillot, 1818a)	Bula Plain/Bens- bach	Trematoda (Digenea)	<i>Neodiplostomum spathula</i> (Creplin, 1829)	Small intestine
	"	Bula Plain/Bens- bach	Cestoda (Cyclophyllidea)	<i>Paradilepis urceus</i> (Wedl, 1855)	Small intestine
	"	Bula Plain/Bens- bach	Cestoda (Cyclophyllidea)	<i>Parvitaenia milvi</i> (Singh, 1952)	Small intestine
	"	Bula Plain/Bens- bach	Nematoda (Ascaridida)	<i>Contracaecum</i> sp.	Small intestine
	"	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Colpocephalum turbinatum</i> Denny, 1842	Body surface & feathers
	"	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Laemobothrion</i> (L.) <i>maximum</i> (Scopoli, 1763)	Feathers
Birds (Coraci- iformes)	Rufous-bellied Kookaburra <i>Dacela gaudichaud</i> Quoy et Gaimard, 1824	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Emersoniella</i> sp.	Feathers
	"	Bula Plain/Bens- bach	Insecta (Siphonaptera)	<i>Xenopsylla vexabilis</i> Jordan, 1925	Body surface
	Spangled Kookaburra <i>Dacelo tyro</i> G. R. Gray, 1858	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Alcedoecus</i> sp.	Feathers
	"	Bula Plain/Bens- bach	Insecta (Phthiraptera)	Species not identified	Feathers
Birds (Falconi- formes)	Brown Falcon <i>Falco berigora novae- guineae</i> (Meyer, 1894)	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Craspedorhynchus</i> sp.	Feathers
	"	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Degeeriella rufa</i> (Burmeister, 1838)	Head feathers
	"	Bula Plain/Bens- bach	Insecta (Phthiraptera)	Species not identified	Feathers
	Australian Hobby <i>Falco longipennis</i> Swainson, 1838	Bula Plain/Bens- bach	Nematoda (Spirurida)	<i>Serratospiculum tendo</i> (Nitzsch, in Giebel, 1857)	Air sacs
Birds (Passeri- formes)	Little Strikethrush <i>Colluricincla megarhyn- cha</i> (Quoy et Gaimard, 1830)	Bula Plain/Bens- bach	Acari (Sarcoptiformes)	<i>Trouessartia</i> sp.	Feathers
	Black-faced Cuckoo- shrike <i>Coracina novaehollandi- ae</i> (Gmelin, 1789)	Bula Plain/Bens- bach	Nematoda (Spirurida)	<i>Diplotriaena tridens</i> (Molin, 1858)	Body cavity
	"	Bula Plain/Bens- bach	Nematoda	Species not identified	?
	"	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Brueelia</i> sp.	Feathers
	"	Bula Plain/Bens- bach	Insecta (Phthiraptera)	<i>Phlopterus</i> sp.	Body surface, feathers
	"	Bula Plain/Bens- bach	Insecta (Phthiraptera)	Species not identified	Feathers
	"	Bula Plain/Bens- bach	Acari (Sarcoptiformes)	<i>Gabucinia</i> sp.	Feathers



Table 1 (continuation)

	Torresian Crow <i>Corvus orru</i> Bonaparte, 1850	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Brueelia</i> sp.	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Colpocephalum fragile</i> Denny, 1842	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Myrsidea</i> sp.	Feathers
	"	Bula Plain/Bensbach	Insecta (Phthiraptera)	Species not identified	Feathers
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Haemaphysalis bancrofti</i> Nuttall et Warburton, 1915	Body surface
	"	Bula Plain/Bensbach	Acari (Mesostigmata)	Species not identified	Feathers
	Hooded Butcherbird <i>Cracticus cassicus cassicus</i> Boddaert, 1783	Bula Plain/Bensbach	Cestoda (Cyclophyllidea)	dilepid species not identified	Small intestine
	"	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Diplotrinaena ?epsilon</i> Johnston et Mawson, 1940	? Body cavity
	Spangled Drongo <i>Dicrurus bracteatus</i> Gould, 1842b	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Philopterus</i> sp.	Body surface, feathers
	"	Bula Plain/Bensbach	Acari (Sarcoptiformes)	<i>Trouessartia</i> sp.	Feathers
	Common Cicadabird <i>Edolisoma tenuirostre</i> (Jardine, 1831)	Bula Plain/Bensbach	Insecta (Phthiraptera)	<i>Philopterus</i> sp.	Body surface, feathers
	Large-billed Gerygone <i>Gerygone magnirostris</i> Gould, 1842b	Ok Tedi, Kiunga, Middle Fly River	Aves (Cuculiformes)	<i>Chalcites minutillus</i> (Gould, 1859)	Eggs in nest
	Brown Oriole <i>Oriolus szalayii</i> (Madarász, 1900)	Bula Plain/Bensbach	Cestoda	Species not identified	?
	Tawny-breasted Honeyeater <i>Xanthotis flaviventer saturator</i> (Rothschild & Hartert, 1903)	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Diplotrinaena</i> sp.	Body cavity
Reptiles (varanids)	Gould's Monitor/Goanna <i>Varanus gouldii</i> (Gray, 1838)	Bula Plain/Bensbach	Cestoda (Proteocephalidea)	<i>Kapsulotaenia</i> sp.	Intestine
	"	Bula Plain/Bensbach	Cestoda (Pseudophyllidea)	'sparganum'	Under skin
	"	Bula Plain/Bensbach	Nematoda	3 species not identified	Stomach
	"	Bula Plain/Bensbach	Acanthocephala	'cystacanth'	Intestine
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Amblyomma fimbriatum</i> Koch, 1844	Body surface
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Amblyomma</i> sp.	Body surface
	Mangrove Monitor/Goanna <i>Varanus indicus</i> (Daudin, 1802)	Bula Plain/Bensbach	Acari (Ixodida)	<i>Amblyomma trimaculatum</i> (Lucas, 1878)	Body surface
	Emerald Tree Monitor/Goanna <i>Varanus prasinus</i> Schlegel, 1839	Daru Is.	Acari (Ixodida)	<i>Amblyomma fimbriatum</i> Koch, 1844	Body surface
	Papua Monitor/Goanna <i>Varanus salvadorii</i> (Peters et Doria, 1878)	Bula Plain/Bensbach	Cestoda (Proteocephalidea)	<i>Proteocephalus</i> sp. prob. <i>sac-cifera</i> (Ratz, 1900)	Intestine
	"	Bula Plain/Bensbach	Cestoda (Pseudophyllidea)	'sparganum'	Body mesentery
	"	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Hastospiculum</i> sp.	Thoracic cavity
	"	Bula Plain/Bensbach	Nematoda (Spirurida)	<i>Tanqua tiara</i> (Linstow, 1879)	Stomach
	"	Bula Plain/Bensbach	Acari (Ixodida)	<i>Amblyomma fimbriatum</i> Koch, 1844	Body surface
	"	Bula Plain/Bensbach	Crustacea (Pentastomida)	Species not identified	Lungs
	Monitor/Goanna <i>Varanus</i> sp.	Bula Plain/Bensbach	Nematoda	2 species not identified	Stomach
Reptiles (crocodiles)	New Guinea Crocodile <i>Crocodylus novaeguinae</i> Schmidt, 1928	Daru Is., Lake Murray	Trematoda (Digenea)	<i>Cyathocotyle (Suchocyathocotyle) crocodili</i> Yamaguti, 1954	Intestine, rectum
	"	Lake Murray	Trematoda (Digenea)	<i>Exotidendrum</i> sp.	Large intestine
	"	Lake Murray	Nematoda (Spirurida)	<i>Micropleura</i> sp.	Body cavity



Table 1 (continuation)

	“	Lake Murray	Nematoda (Ascaridida)	<i>Dujardinascaris</i> sp.	Stomach
	“	Lake Murray Daru Is.	Annelida (Hirudinida) Protozoa (Piroplas- morida)	<i>Placobdella</i> sp. 'haemogregarines'	Body surface Red blood cells
Reptiles (che- lonids)	Northern Snake-necked Turtle <i>Chelodina rugosa</i> Ogilby, 1890	Aramia River	Monogenea	<i>Polystomoides</i> sp.	Bladder
Reptiles (snakes)	Arafura File Snake <i>Acrochordus arafurae</i> McDowell, 1979	Bensbach River	Nematoda (Spirurida)	<i>Tanqua ophidis</i> Johnston et Mawson, 1948	Stomach
Amphibia (frogs)	Angiana Tree Frog <i>Litoria angiana</i> (Bou- lenger, 1915)	Star Mountains	Annelida (Hirudinida)	<i>Leiobdella singularis</i> (Richard- son, 1975)	Beneath skin, body cavity
	Beck's tree frog <i>Litoria becki</i> Loveridge, 1945	Star Mountains	Annelida (Hirudinida)	<i>Leiobdella singularis</i> (Richard- son, 1975)	Beneath skin, body cavity
	Sandy Big-eyed Tree Frog <i>Nyctimystes kubori</i> (Zweifel, 1958)	Star Mountains	Annelida (Hirudinida)	<i>Leiobdella singularis</i> (Richard- son, 1975)	Beneath skin, body cavity
	Common Big-eyed Tree Frog <i>Nyctimystes nari- nosa</i> Zweifel, 1958	Star Mountains	Annelida (Hirudinida)	<i>Leiobdella singularis</i> (Richard- son, 1975)	Beneath skin, body cavity
	Mountain Swamp Frog <i>Papurana grisea</i> (van Kampen, 1923)	Star Mountains	Annelida (Hirudinida)	<i>Leiobdella singularis</i> (Richard- son, 1975)	Beneath skin, body cavity
Fishes (fresh- water, migra- tory)	Catfish <i>Arius</i> sp.	Bensbach River	Cestoda (Trypanorhyn- cha)	<i>Poecilacanthum oweni</i> Palm, 1995 (plerocerci)	Musculature
	“	Tirere village near Daru	Crustacea (Copepoda)	<i>Ergasilus</i> sp.1	Gills
	Barramundi <i>Lates calcarifer</i> (Bloch, 1790)	Bensbach River	Nematoda (Ascaridida)	<i>Cucullanus hians</i> (Dujardin, 1845)	Intestine
	“	Bensbach River	Nematoda (Ascaridida)	<i>Dujardinascaris</i> sp. (larvae)	Mesenteries
	“	Bensbach River	Nematoda (Spirurida)	<i>Philometra ?lateolabracis</i> (Yamaguti, 1935)	Ovaries
	“	Bensbach River	Nematoda	Species not identified	Mesentery
	“	Bensbach River	Acanthocephala (Echinorhynchida)	<i>Longicollum edmonds</i> Golvan, 1969	Intestine
	“	Bensbach River	Crustacea (Copepoda)	<i>Ergasilus</i> sp.2	Gills
	Papuan Blackbass <i>Lutjanus goldiei</i> (Ma- cleay, 1882)	Balimo	Trematoda (Digenea)	'didymozoid', possibly <i>Metane- matobothrium</i> sp.	Coiled in dorsal muscle
	Sawfish <i>Pristis microdon</i> Latham, 1794	Lake Murray	Monogenea	<i>Nonacotyle pristis</i> Ogawa, 1991	? Gills
	“	Lake Murray	Monogenea	<i>Pristionchocotyle papuensis</i> Ogawa, 1991	? Gills
	“	Lake Murray	Nematoda (Ascaridida)	<i>Hysterothylacium</i> sp.	Intestine
	“	Lake Murray	Nematoda	Species not identified	Intestine
	Saratoga <i>Scleropages jardinii</i> (Saville-Kent, 1892)	Fly River	Nematoda (Ascaridida)	<i>Brevimulticaecum scleropagi</i> Khalil, 1984	Stomach
	“	Bensbach River	Crustacea (Copepoda)	<i>Lernaea papuensis</i> Boxshall, 1981	Gill arches
Fishes (marine, migratory)	'marine fish'	Torres Strait near Kaviopo village	Nematoda	'unidentified tangled mass of larvae'	Body cavity mesenteries
	“	Torres Strait near Kaviopo village	Crustacea (Copepoda)	<i>Ergasilus</i> sp. 2	Gills
	'tuna'	Torres Strait near Kaviopo village	Cestoda (Trypanorhyn- cha)	'plerocerci'	Connective tissue
	Threadfin <i>Eleutheronema</i> sp.	Torres Strait near Kaviopo village	Cestoda (Trypanorhyn- cha)	'plerocerci'	Body cavity, muscle
	“	Torres Strait near Kaviopo village	Acanthocephala	Species not identified	Intestine
	King Threadfin <i>Polydactylus macrochir</i> (Günther, Siphonaptera)	Gulf of Papua	Cestoda (Trypanorhyn- cha)	<i>Poicilancixtrum</i> sp. ? <i>caryophyl- lum</i> (Diesing, 1850) (plerocerci)	Musculature
	“	Torres Strait	Cestoda (Trypanorhyn- cha)	'plerocerci'	Gill canals
	“	Torres Strait	Nematoda (Ascaridida)	<i>Goezia</i> sp. (larvae)	Within trypano- rhynch plero- cerci cysts
Insects (Hyme- noptera)	Asian Honeybee <i>Apis cerana</i> Fabricius, 1793	Kiunga	Acari (Mesostigmata)	<i>Varroa jacobsoni</i> Oudemans, 1904	Body surface, worker & drone broods



Review of parasites of animals in Western Province, Papua New Guinea

Parasites of non-native domestic animals

Domestic animals, other than pigs, dogs and, in some localities, chickens have been present in the country only for the last hundred years or so.

Ruminants, horses and cats

At present, cattle are few in numbers in WP. Most, it seems, are no longer under control and have become feral in localities such as Suki and Balimo. Goats have diminished in number also, and there are no sheep currently recorded in the province. A few horses (Timor ponies), that are mostly feral, occur in the Wando area of Bula Plain/Bensbach. Cats are found in most communities other than in some remote villages. They are few in numbers, some having become feral but usually remaining close to human habitation. Their effect as hunters on local fauna is possibly significant (Flannery & Seri 1990).

The only endoparasites recorded from the domestic ruminants are nematodes from goats; *Haemonchus contortus* (Rudolphi, 1803), *Oesophagostomum columbianum* Curtice, 1890, *Strongyloides* sp. and *Trichstrongylus* sp. There are no records of horses being examined for endoparasites but the presence of 'swamp cancer', a fungal disease, in an animal at Wando indicates that the nematode *Habronema* sp. is present as its larvae are associated with the fungal infection. Likewise, there are no records of parasites of cats in WP, although elsewhere in the country they have some of the same parasites as dogs.

Three ectoparasites are known to occur on some of these imported domestic animals. The tick, *Rhipicephalus (Boophilus) australis* (Fuller, 1899) that infests cattle, was confused until recently with *R. (B.) microplus* (Canestrini, 1888) (Estrada-Pena et al. 2012). The dipteran flies, *Haematobia irritans exigua* (Meijere in Schat, 1903) occurs on cattle, and *Chrysomya bezziana* Villeneuve, 1914 on cattle and horses (as well as other domestic and wild animals). The latter insect, commonly known as the Old World screw-worm fly, unlike the other two ectoparasites, is long-established in the country. It found a ready source of suitable hosts with the arrival of new types of imported livestock. The wounds its larvae (maggots) produce are debilitating and can be fatal.

Parasites of long-established domestic animals

Dogs

Dogs have been in PNG, and probably WP, for at least a couple of thousand years; no one knows for sure when they were brought into the country. They form an essential part of most village families and are especially important to hunters and, increasingly, for security. They are often poorly fed, sometimes having to fend for themselves and consequently can be in poor condition, particularly when present in excessive numbers as, for example, a village in Middle Fly region was recorded at one time as having 300 dogs, 23 of them with one owner. It means that many are likely to have more problems with parasites than they otherwise might have. A number of feral dogs inhabit Bula Plain/Bensbach area that predate on young fawns in particular (Hitchcock 2004), and wild dogs, or what are known as New Guinea singing dogs, are recorded by Flannery & Seri (1990) in the subalpine grassland of Dokfuma in the Star Mountains.

Few dogs in WP have been examined for parasites but they are known to have a hookworm, *Ancylostoma* sp., and the heartworm, *Dirofilaria immitis* (Leidy, 1856) is common. Heartworm (Fig. 7), when present in large numbers in the heart or pulmonary artery, can block blood flow to the lungs that may lead to the collapse of the dog, and sometimes death. Ectoparasites found on dogs include the chewing louse, *Heterodoxus spiniger* (Enderlein, 1909), the flea, *Ctenocephalides f. felis* (Bouché, 1835), and the screw-worm fly *Chrysomya bezziana*. The absence of the dog tick, *Rhipicephalus sanguineus* (Latreille, 1806) and mange producing mites, is likely to reflect the low number of hosts examined, as they are recorded almost universally in the country.

Pigs

Domestic pigs are an integral part of most village families in PNG, other than where wild pigs are plentiful, as in much of the southern part of WP where, if kept, they are caught as wild piglets and usually penned. Pigs are "cultural superfood" for the people of Bula Plain/Bensbach according to Hitchcock (2004). Wild and village pigs often cross-breed and are considered to be of the same lineage (Groves 1981; Ayalaw et al. 2011). The time of arrival of pigs into the country is uncertain but generally believed to be 3000 to 4000 years ago (Hide 2003). As the parasites of domestic and wild



pigs are similar, and as many more wild pigs have been examined than domestic ones, their parasites are considered when discussing those of wild pigs.

Chickens

Some coastal areas in the country are known to have had chickens for a few centuries, but they did not become widespread until the 20th century. Today they are found probably in most WP villages. They harbour both ecto- and endo-parasites.

Although no protozoan parasites have been recorded from WP chickens, the various coccidial species (*Eimeria*) are ubiquitous in PNG and almost certainly present in WP. The tapeworms, *Hymenolepis exigua* (Yoshida, 1910), *Raillietina echinobothrida* (Megnin, 1881) and *Amoebotaenia cuneata* (Linstow, 1872) are common in the province, the latter species, possibly, being the most harmful. A small flatworm, *Prosthogonimus ovatus* (Rudolphi, 1803), that occurs in oviducts, can affect egg production. Nematodes found include *Capillaria* sp., the eyeworm *Oxyspirura mansoni* (Cobbold, 1879), *Trichostrongylus tenuis* (Mehlis in Creplin, 1846) and *Heterakis gallinarum* (Schrank, 1788). The only acanthocephalan recorded is *Mediorhynchus gallinarum* (Bhalarao, 1937).

A few ectoparasites have been recorded from WP chickens, including the chewing lice *Cuclotogaster heterographus* (Nitzsch in Giebel, 1866) and *Menopon gallinae* (Linnaeus, 1758). Heavy infestations are seldom seen as village chickens are not kept in conditions of close contact. The only mite recorded is the scaly leg mite, *Knemidocoptes mutans* (Robin et Lanquetin, 1859).

Parasites of wildlife

Investigations were conducted into the parasites of WP wildlife over several decades, primarily in the Bula Plain / Bensbach River section of the Tonda Wildlife Management Area. This south western locality has distinct wet and dry seasons, with much of the land under water for part of the year, alternating often with drought conditions (Fig. 3).

Deer

Rusa deer (*Cervus timorensis* Blainville, 1822) occur in southern WP and were first observed in the Bula Plain / Bensbach area during late 1930s, having spread across the border from adjacent West

Papua. They have thrived to become a major food source for local people and have spread eastwards, crossing the Fly River. A survey conducted on the grasslands of Bula Plain / Bensbach area in 1987 recorded an estimate of 23700 animals (Fraser-Stewart 1988). Numbers have diminished since due to increased hunting and poaching; severe drought conditions, as occurred in 1997/8, can lead to a high mortality (Hitchcock 2004). The presence of the deer has had a “profound impact on the local environment” (Hitchcock 2004).

The deer (65 were autopsied over 32 years) had no nematode parasites, which is unusual for herding ruminants. They were parasitized by two species of digenean flatworms, *Homalogaster paloniae* Poirier, 1883, and *Fiscoederius elongatus* (Poirier, 1883). Large numbers of the latter species were frequently found in the rumen with no apparent harmful effect on the host (Fig. 8). *Homalogaster*, on the other hand, was always few in numbers, and was not seen following the severe drought of 1997/8 which may have had a deleterious effect on its molluscan intermediate host. The apparently benign protozoan *Theileria mutans* (Theiler, 1906) parasitized the red blood cells of most animals.

The cattle tick, *Rhipicephalus (Boophilus) australis* (Fuller, 1899), was a common ectoparasite (78% parasitism), but animals carried more larvae and nymphs than adults. Rusa deer is a supple animal with a bristly coat, whose hair is readily erected – factors that may help remove adult ticks during self-grooming. Deer sometimes cover themselves with mud that is sloughed off when dry, an action which may also help remove large adult ticks. Infestation tended to be heaviest in the dry season, particularly for males and non-pregnant females (Owen 1977). The ability of the deer to carry the cattle tick presents a problem for cattle farmers. Another tick, *Amblyomma papuanum* Hirst, 1914, was recorded on one occasion. Three cases of screw-worm fly lesions were seen.

Wild (and village) pigs

About 80 pigs (mostly wild) have been examined for parasites, almost all from the southern part of the province. The few ectoparasites recorded comprise of the louse *Haematopinus suis* (Linnaeus, 1758), the flea *Ctenocephalides felis* (Bouché, 1835) and the mite *Sarcoptes scabiei* (Linnaeus, 1758).

Common nematodes found in both wild and village pigs included the lungworm, *Metastrongylus pudendotectus* (Vostokov, 1905), the gut worms



Ascaris suum (Goeze, 1782), *Gnathostoma doloresi* (Tubangui, 1925), *Oesophogostomum quadrispinulatum* Marcone, 1901, *Physocephalus sexalatus* (Molin, 1860) and the long, threadlike *Setaria thomasi* (Sandosham, 1954) found in the body cavity. A nematode of the tongue, *Capillaria papuensis* Copland, 1975, so far, reported only from PNG, was present in 29% of wild pigs on Bula Plain.

A zoonotic nematode, *Trichinella papuae* Pozio, Owen, La Rosa, Sacchi, Rossi et Corona, 1999, was first detected in village and wild pigs in 1988 and later, with serological testing, humans were found to be infected (Owen *et al.* 2001; 2005). It is an unusual worm in that both adults and larvae infect the same host, with the minute adults living in the intestine and larvae in striated muscle fibres (Fig. 9). It is unusual, also, in being able to parasitize both warm and cold-blooded (crocodile) hosts. About 11% of wild pigs on Bula Plain were infected and 10% of villagers in Morehead District tested positive. Domestic pigs become infected by being fed contaminated wild pig meat, while eating uncooked or undercooked infected pig meat leads to human infection. Another zoonotic parasite found in pigs was the protozoan *Balantidium coli* (Malmsten, 1857).

The large acanthocephalan or thorny-headed worm, *Macracanthorhynchus hirudinaceus* (Pallas, 1781) is a common intestinal parasite of wild pigs (Fig. 10). It may be a problem for the host if present in appreciable numbers as it can damage and penetrate the gut wall.

Dugongs

Parasites of the dugong, *Dugong dugon* (Müller, 1776), which lives in the shallow coastal waters of WP, include at least six species of flatworms, occupying locations ranging from the middle ear and Eustachian tubes, to the lungs, stomach, intestine, liver, and pancreas, but with only one nematode species reported (Blair 1981).

Bats

Bats have been examined for parasites from three localities, the Bula Plain / Bensbach area, Ok Tedi, and Black River in the Blucher Range. Those from the latter two localities were museum specimens preserved and stored in 70% alcohol. None of the fruit bats, flying foxes and blossom bats (Megachiroptera) (34 individuals examined) contained endoparasites, but Peters (1957)

recorded *Hepatocystis* sp., a malaria-like parasite, and microfilariae in the blood of WP flying foxes. Amongst the insectivorous bats (Microchiroptera) (24 individuals examined), most had at least one type of endoparasite. This points to the role insects may play in the lifecycles of bat endoparasites that require intermediate hosts. Ectoparasites, on the other hand, were found on both insectivores and frugivores, but less often on the former than the latter group. Mites were present on both groups but dipteran batflies occurred only on Megachiroptera. None was heavily parasitized with either of the parasite types. On one occasion an ectoparasitic mite, *Meristaspis calcarata* (Hirst, 1923) was found attached to the wing rib of a microchiropteran, *Emballonura r. raffrayana* (Dobson, 1879) - an accidental infestation probably, as it is a parasite of *Pteropus* sp., a megachiropteran. Many of the bat parasites have yet to be identified.

Rodents

Rodents have been examined from the extreme south and the extreme north of the province. Included in this account of the northern group are animals from sites in the Star Mountains region, such as Tifalmin, Bafunmin, Telefomin and Feramin, that lie adjacent to, but on the Sandaun side of, the border with WP. This group contained a greater range of host species than did the southern group from Bula Plain/Bensbach. The northern rodents also harboured a larger range of parasites; *Rattus niobe* (Thomas, 1906) and *Paramelomys lorentzii* (Jentink, 1908) had 14 and 11 species (discounting larvae and juveniles) of endoparasites respectively, dominated largely by strongylid nematodes, while the highest numbers in the southern hosts were seven endoparasites in *Melomys lutillus* (Thomas, 1913) and six in *Rattus leucopus* (Gray, Siphonaptera). Five parasite species were present in both northern and southern hosts, namely, the cestodes *Hymenolepis diminuta* (Rudolphi, 1819) and *Raillietina celebensis* (Janicki, 1902), and the nematodes *Odilia mackerrasae* (Mawson, 1961), *O. melomyos* (Mawson, 1961) and *Trichuris muris* (Schränk, 1788).

Ectoparasites of rodents have been little studied. So far, it seems, fleas are the only ones reported from the northern based rodents other than for two species of tick. Twenty-three species of fleas were recorded by Hastriter & Easton (2013) and Hastriter (2014; 2015; 2016) on a range of murid hosts. *Acanthopsylla enderleini* (Wagner, 1933) was the most common, occurring



on 10 host species, followed by *Orthopsylloides uncinata* Hastriter, 2014 on eight species. The ticks comprise of *Ixodes priscicollaris* Schulze, 1932, found on three species of rodents and *I. goliath* Apanaskevich et Lemon, 2018 on one. Only two flea species are recorded from the southern region; *Xenopsylla vexabilis* Jordan, 1925 on *Rattus leucopus* from the Bula Plain/Bensbach area and *Orthopsylloides andersoni* George et Beaucournu, 1995 on *Melomys* sp. from Trans Fly area of the province. The lice *Hoplopleura pacifica* Ewing, 1924 and *Hoplopleura* sp. were found on *Rattus* sp. and *Melomys* sp. respectively, and nymphal stages of the tick *Haemaphysalis humerosa* Warburton et Nuttall, 1909 were collected from *Melomys* spp. Mites (*Laelaps* spp.) occurred on species of *Melomys* and *Rattus*, with *L. rothschildi* Hirst, 1914 a common parasite of *Melomys lutillus* (Thomas, 1913).

Marsupials

Parasites have been recorded from about ten species of marsupials. One of the iconic animals of the Bula Plain savannah is the agile wallaby, *Macropus agilis* (Gould, 1841). As with deer and wild pigs, and for the same reasons, there has been a marked decline in numbers during recent times, despite the area being part of the Tonda Wildlife Management Area.

A large range of parasites is recorded from the wallaby (24 were examined), including two species of flatworms, two tapeworm species, 16 nematode species (of which 13 were strongylids), three species of lice, one tick species and four species of mites. The most common endoparasites were the nematodes *Labiostongylus labiostongylus* Yorke et Maplestone, 1926 and *Cloacina cornuta* (Davey et Wood, 1938) found in 11 and 10 individuals respectively. The most frequently seen ectoparasite was the tick *Haemaphysalis bancrofti* Nuttall et Warburton, 1915 recovered from six animals. In addition, two species of dung beetles, *Onthophagus parvus* Blanchard, 1853 and *O. symbioticus* (Arrow, 1920), have an association with the wallaby but were encountered only on animals seen at night. The nocturnal beetles are firmly attached around the host cloacal opening with the aim of acquiring dung pellets as these are passed out. The two species have slightly different adaptations of the claws for grasping the host's fur (Matthews 1972). The beetles should be viewed probably as pseudoparasites or, possibly, as practicing commensalism as depicted by Combes

(2005). The presence of these beetles can explain finding the mite *Aliphis* sp. on a wallaby as the mite is often found on scarabid dung beetles (Krantz & Walter 2009).

A much less frequently seen marsupial was the pademelon or red-legged wallaby, *Thylogale stigmatica oriomo* (Tate et Archbold, 1935b) (3 were examined). It is shy and more solitary than the agile wallaby, preferring a mixed woodland/savannah than an open savannah environment and is restricted to the southern Trans Fly area of New Guinea. Its range of nematode species (21) is even greater than that of the agile wallaby. One, apparently healthy, animal contained 32270 nematode worms, comprising of 17 species in the stomach alone.

Agile wallabies and pademelons occur in the same locality but they harbour different parasites. Worms of the same genus may be found in both, such as, the nematode genera *Cloacina* von Linstow, 1898, *Pharyngostongylus* Yorke et Maplestone, 1926, *Popovastrongylus* Mawson, 1977 and the tapeworm *Progamotaenia* Nybelin, 1917, but no species of these genera was found common to both hosts. This may reflect, in part, on a difference in diet; the agile wallaby is primarily a grazer, while the pademelon is more of a browser, reported to feed mainly on fruit and understorey plants (Flannery 1995).

Another wallaby, *Dorcopsis luctuosa* (D'Albertis, 1874) (wrongly identified in the past as *D. veterum* (Lesson, 1827)), from the Middle Strickland area, had species of nematodes that are largely confined to this host, such as, *Dorcopsisstrongylus labiocarinatus* Smales, 1982a, *Labiostongylus redmondi* Smales, 1982b, *Paralabiostongylus bicollaris* Smales, 1982b and *Dorcopsinema dorcopsis* (Baylis, 1940).

The smaller marsupial species from the southern part of the province had relatively few parasites. Of the 23 dunnarts (*Smynthopsis* spp.) examined, only six harboured endoparasites comprising of possibly four nematode species, two species of tapeworms and a protozoan (*Sarcocystis* sp.); no ectoparasites were seen. The striped possum (*Dactylopsila trivirgata* J. E. Gray, 1858) and *Dactylopsila* sp. had two nematode species and a species of *Sarcocystis*. Only a muscle biopsy, that revealed a *Sarcocystis* sp. infection, was possible with the carnivorous quoll (*Dasyurus albopunctatus* Schlegel, 1880). Two bandicoot species were examined from the Bula Plain/Bensbach area; *Echymipera kalubu* (Fischer, 1829) had four nematode species, an acanthocephalan,



a tick and a mite, while *Isoodon macrourus* (Gould, 1842a) had a tapeworm, a louse and two species of ticks.

Small marsupials from elsewhere in the province have not been studied for endoparasites, but 14 species of fleas have been recorded by Hastriter & Easton (2013) and Hastriter (2014; 2015; 2016) from about 14 host species at locations near the northern border; these were examined for ectoparasites only. As with rodents, *Acanthopsylla enderleini* (Wagner, 1933) was the most prevalent, being recorded on eight different marsupial species. The largest number of flea species reported on a host species was eight on the bandicoot *Microperoryctes longicauda* (Peters & Doria, 1876).

Birds

The Bula Plain / Bensbach area is a focal point for a variety of birds. It is virtually the only locality of the province where birds have been examined for parasites. Thirty-six species were examined during the surveys – 10 visitors or migrants, nine endemics, while 17 were resident species, of which possibly nine may have included both resident and visitor populations. Forty-seven of 49 individual birds examined had one or more species of parasite. They were far more likely to have ectoparasites than endoparasites, amounting to 56 and 32 species respectively. Levels of parasitism with ecto- and endo- parasites amongst resident and migratory/visitor species were similar. The two individual birds that had no parasites were an Australian pratincole (*Stiltia isabella* (Vieillot, 1816)) and a sharp-tailed sandpiper (*Calidris acuminata* Horsfield, 1821).

Feather or chewing lice were the most frequently seen ectoparasites. At least 49 species were recorded, of which 31 have been identified to species, 18 to genus, while the remainder await identification. The Australian white ibis, *Threskiornis molucca* (Cuvier, 1829), the Torresian crow, *Corvus orru* Bonaparte, 1850, the wandering whistling duck, *Dendrocygna arcuata australis* (Reichenbach, 1850) and the curlew sandpiper, *Calidris ferruginea* (Pontoppidan, 1763) each had four different species of chewing lice. No avian host, however, was particularly heavily infested. Of those lice identified to species, *Actornithophilus umbrinus* (Burmeister, 1838) was the only one found on three host species, namely, shorebirds (*Calidris* spp.). These shorebirds (order Charadriiformes) were parasitized also by members of the same genera of other lice but, with current identification,

usually different species. One louse, *Holomenopon leucoxanthum* (Burmeister, 1838), recovered from a wandering whistling duck, has a reputation overseas of rendering feathers of water birds no longer waterproof, a condition that can lead to pneumonia.

The double-wattled or southern cassowary (*Casuarus casuarus* (Linnaeus, 1758)) is parasitized in the Bensbach area by a species of chewing louse, *Therodoxus oweni* Clay, 1971, which is considered unusual as members of the family Boopidae are parasites of mammals. Its recovery on more than one occasion and the presence of both sexes, precludes the possibility of accidental infestation. Also exceptional was the discovery of the mammalian scabies mite, *Sarcoptes scabiei* (Linnaeus, 1758) infesting the head and neck region of a cassowary in the Balimo area. Again, finding a similar case in Southern Highlands Province precludes accidental infestation. The only ticks found on birds were *Amblyomma papuanum* Hirst, 1914 on a cassowary and a megapode (*Talegalla* cf. *fuscirostris* Salvadori, 1877), and *Haemaphysalis bancrofti* Nuttall et Warburton, 1915 on a Torresian crow. Two insects were recovered from birds: a flea *Xenopsylla vexabilis* Jordan, 1925 on a rufous-bellied kookaburra (*Dacelo gaudichaud* (Quoy et Gaimard, 1824) and a louse fly (*Icostia* sp.) on an Australian white ibis.

Nematod species (16) were the most numerous bird endoparasites, followed by cestodes (12), digeneans (12) and acanthocephalans (three). No endoparasites were recorded in 17 host species but, as the examinations were carried out under field laboratory conditions, very small or single worms might have been overlooked. The nematodes included three (possibly four) species of *Contracaecum* Railliet et Henry, 1912 and two (possibly three) of *Diplotriaena* Railliet et Henry, 1909. It is noteworthy that only one of nine species of shorebirds (Charadriiformes) contained a nematode parasite. The most common cestodes were members of the family Dilepididae, that included *Paradilepis* Hsü, 1935, *Parvitaenia* Burt, 1940, and *Megacirrus* Beck, 1951. Diverse species of digeneans were recorded in different hosts, with members of only one genus (*Apatemon*) occurring in more than one host species (ducks). Few blood samples were collected and no parasites were detected. This reflects on the low number examined probably, as Ewers (1967) found 37% parasitism in the blood of birds in another PNG lowland locality.

Cuckoos and koels are well known for parasitizing other birds. About 12 species



(disregarding vagrants) have been recorded in WP, of which at least eight are resident/endemic practicing brood parasitism (Table 2). The remainder are non-breeding visitors (Beehler & Pratt 2016). Most sightings come from the northern half of the province where the avifauna is most studied by bird watchers. In literature available to the author, it appears there is only one published record of cuckoo eggs being found in a host-bird nest in WP – namely, in nests of the Large-billed Gerygone or warbler (*Gerygone magnirostris* Gould, 1842) in the Middle Fly area (Rand & Gilliard 1967). The Little Bronze Cuckoo, *Chalcites (Chrysococcyx) minutillus* (Gould, 1859) was the likely culprit as it was the only cuckoo species seen in the area at the time. There is another record in PNG of this cuckoo parasitizing a species of honeyeater near the coastal town of Vanimo, Sandaun Province of New Guinea (Gómez & Garza 1993).

Reptiles

Four species of monitor lizards or goannas (*Varanus* spp.) (nine individuals were examined) inhabit Bula Plain; all carry ticks of the genus *Amblyomma*. Of the seven species of nematodes recovered, only one, *Tanqua tiara* (Linstow, 1879), has been identified to species. Sparganum, the larval stage of a tapeworm, *Spirometra* sp., occurred in the muscle of *V. gouldii* (Gray, 1838), and *V. salvadorii* (Peters et Doria, 1878). An unidentified pentastomid parasite was present in the lungs of *V. salvadorii*.

Crocodiles of WP have been little examined for parasites but the freshwater *Crocodylus novaeguineae* Schmidt, 1928, of Lake Murray is known to have two nematode parasites (*Dujardinascaris* sp. and *Micropleura* sp.), a digenean (*Exotidendrum* sp.) and an ectoparasitic leech (*Placobdella* sp.). A flatworm (*Cyathocotyle crocodili* Yamaguti, 1954) has been recorded in animals from Lake Murray and the Daru area, and a protozoan infecting red blood cells in crocodiles from the latter locality.

There is a dearth of knowledge of parasites of other reptiles in WP. A monogenetic trematode, *Polystomoides* sp. is recorded from the bladder of a freshwater turtle, *Chelodina rugosa* Ogilby, 1890 at Awaba, Aramia River (Fairfax 1990), and a nematode, *Tanqua ophidis* Johnston et Mawson, 1948 in the stomach of an Arafura filesnake, *Acrochordus arafurae* McDowell, 1979, from the Bensbach River. The stomach of a filesnake from the Fly River at Suki had large numbers of, probably,

the same nematod species (Pinney 1976).

Amphibians

There are few records also of parasites of WP frogs. Leeches, *Leiobdella singularis* (Richardson, 1975), are reported as internal parasites of *Papurana grisea* (van Kampen, 1923), *Nyctimystes kubori* (Zweifel, 1958), *N. narinosa* Zweifel, 1958, *Litoria angiana* (Boulenger, 1915) and *L. becki* (Loveridge, 1945) in the Star Mountains (Mann & Tyler 1963; Van der Lande 1994). They occupy either the space between the skin and body wall (dermal lymph sacs), or the body cavity; one or two may be present in a frog. The means of entering and leaving the host is through the cloaca, according to Tyler et al. (1966).

Fishes

Parasites of fishes, likewise, have received little study. Barramundi (*Lates calcarifer* (Bloch, 1790)) harbour four species of nematodes, one being the larvae of *Dujardinascaris* Baylis, 1947 which, as adults, live in crocodiles. Parasitic copepods belonging to the genera *Ergasilus* Nordmann, 1832 and *Lernaea* Linnaeus, 1758 occur on barramundi, saratoga (*Scleropages jardinii* (Saville-Kent, 1892)) and catfish (*Arius* sp.) of the Bensbach River. A Papuan black bass (*Lutjanus goldiei* Macleay, 1882) caught at Balimo had an elongate, thread-like didymozoid flatworm coiled in the host's musculature. Two species of ectoparasites (monogenean trematodes) were recorded on the sawfish, *Pristis microdon* Latham, 1794, in Lake Murray, as well as two nematode species (Ogawa 1991).

Marine fishes, including a species of tuna, a king threadfin salmon (*Polydactylus macrochir* (Günther, Siphonaptera)) and a salmonid (*Eleutheronema* sp.) from the WP coast, contained trypanorhynch plerocerci and the latter host, an unidentified acanthocephalan. The musculature of an unidentified marine fish contained a tangled mass of nematode larvae that could not be identified, and a copepod (*Ergasilus* sp.) was attached to the gills.

Insects

Lepidoptera in PNG are known to have parasites and parasitoids, but none has been described from WP. Nevertheless, several butterfly species known to be infected elsewhere in the country,



occur in the province, such as, *Delias aruna inferna* Butler, 1871, *D. callima satura* Jordan, 1930, *Hypochrysops arronica* (Felder et Felder, 1859), *Candalides helenita dimorphus* (Röber, 1886), *Zizula hylax dampierensis* Rothschild, 1915, and *Euploea batesii rotunda* Van Eecke, 1915 (Parsons 1999). Amongst the parasites and parasitoids found associated with them, and likely to occur in WP, is a midge, *Forcipomyia papuensis* Lane et Cotman, 1986, that feeds on the haemolymph of adult males of high altitude *Delias* spp. by tapping the anal vein on the underside of the hindwings. Its legs have structures adapted to grip the host's wing scales. The butterflies are prone to these attacks while drinking. The most common parasitoids of eggs, larvae and pupae of these butterflies are small chalcid wasps, and tachnid flies. In some cases, they can lead to a 50% or higher mortality of the host (Parsons 1999).

The Asian hive bee, *Apis cerana* Fabricius, 1793, entered the northern part of PNG from Papua Province (Indonesia) in the 1980s and, since then, it has spread to all mainland provinces, including WP. The bees brought with them a mite, *Varroa jacobsoni* Oudemans 1904, which reproduces in the drone brood cells of the bee colony. It infests worker brood cells also but does not reproduce in them. Nevertheless, the mite can lead to a mean worker brood mortality of 38% in PNG, thus affecting the wellbeing of an Asian bee colony.

Parasites with no named hosts (Table 2)

The limestone country of the Star Mountains has an extensive network of caves, where speleologists reported finding an unidentified temnocephalid (a commensal) attached to the carapace of freshwater crabs (Chapman 1976). It was speculated that they fed either on small cyclopoid copepods or on the haemolymph of the host crabs. The caves also had leeches, including a 'pink coloured' species that may, possibly, be *Leiobdella jawareriensis* Richardson, 1974, which occurs in caves, feeding on bats, elsewhere in PNG, and another unidentified 'pimplly skinned' terrestrial leech. None was attached to a host. Lukwi caves on Ok Ma, a tributary of Ok Tedi, had rows of leeches on the roof of a cave, about 50 metres in from the entrance, which the cavers believed were waiting for the return of roosting bats to get their meal of blood. Unidentified ticks were present on leaf platforms in caves used as sleeping quarters by cuscus (*Phalanger* sp.) (Chapman 1976).

Aulicid wasps (Hymenoptera) are

endoparasitoids of wood-boring wasps and beetles; one species, *Pristaulacus kiunga* Jennings et Austin, 2006, has been reported near Kiunga, but no host was identified (Jennings & Austin 2006).

Female mosquitoes are temporary parasites requiring at least one blood meal before they can lay eggs. The anthropophilic species are vectors of human malaria and filariasis in the province. Other species are more zoophilic, preferring non-human, domestic animal or wildlife hosts such as the agile wallaby and flying foxes (Charlwood et al. 1985; Van den Hurk et al. 2003). Some are opportunistic feeders; Colless (1959) reported that females of the nominal species of the *Culex sitiens* Wiedemann, 1828 subgroup fed mainly on birds and pigs, but were also known to bite cattle, dogs and man. The *Flavivirus* that causes Japanese encephalitis in humans was isolated from members of this subgroup of mosquitoes at Lake Murray, Balimo and Abam (inland of Daru) (Johansen et al. 2000). The virus can be transmitted to certain wading birds (Ardeidae) that act as important reservoirs, and to pigs that serve as the primary amplifying host (Hanna et al. 1996). *Culex annulirostris* Skuse, 1889 is a vector of *Dirofilaria immitis* (Leidy, 1856) of dogs.

Amongst anopheline mosquitoes recorded in the province, *Anopheles bancroftii* Giles, 1902, in particular, is zoophilic (Keven et al. 2017) while *A. hinesorum* Schmidt, Foley, Hartel, Williams et Bryan, 2001 and *A. longirostris* Brug, 1928 are considered to be primarily zoophilic (Cooper et al. 2009) or, with other species, such as *A. farauti* s. s. Laveran, 1902 and *A. punctulatus* Dönitz, 1901, opportunistic feeders (Keven et al. 2017). Provincial surveys of anophelines by Cooper et al. (1997; 2002) recorded 10 species that differed in their distribution. *A. farauti* s. s., for example, was confined to the coast, *A. longirostris* to the mountainous NW corner, and *A. bancroftii* largely to the Middle Fly region. Only *A. hinesorum* had a province-wide distribution. The presence of the filarial nematode *Setaria thomasi* Sandosham, 1954 in pigs indicates that its mosquito vector (probably an anopheline) exists in WP.

Tabanid flies (horseflies), feed on animal blood and, when doing so, inflict painful bites, leading to avoidance actions by many animals. Some act as carriers of protozoan blood parasites. At least 20 tabanid species have been recorded in WP (Mackerras 1964) (Table 2).



Table 2. Bird, arthropod and annelid parasites and parasitoids with no named hosts, recorded in Western Province, Papua New Guinea.

Legends: Key to bird residency status: E = endemic; R = resident; R/V = resident & visitor; V/?R = visitor & possibly resident].

Parasite Group	Parasite	Locality
Birds (Cuculiformes, Cuculidae)	Black-capped Cuckoo or Dwarf Koel <i>Microdynamis parva</i> (Salvadori, 1875b) E	Ok Menga, Ok Tedi, Kiunga, Fly River
	Eastern or Common Koel <i>Eudynamis subcyanocephalus</i> Mathews, 1912 V/?R	Kiunga, Tabubil hill forest, Fly River, Morehead
	Channel-billed Cuckoo <i>Scythrops novaehollandiae</i> Latham, 1790 V/?R	Kiunga, Fly River
	Long-billed Cuckoo <i>Rhamphomantis megarhynchus</i> (G. R. Gray, 1858) E	Kiunga
	White-eared Bronze-Cuckoo <i>Chalcites meyerii</i> (Salvadori, 1874) E	Ok Tedi hill forest
	White-crowned Cuckoo <i>Caliechthrus leucolophus</i> (Müller, 1840) E	Ok Tedi hill forest
	Chestnut-breasted Brush-Cuckoo <i>Cacomantis castaneiventris</i> Gould, Siphonaptera R	Tabubil, Fly River
	Fan-tailed Cuckoo <i>Cacomantis flabelliformis</i> (Latham, 1801) R/V	Higher altitudes of Ok Tedi
	Grey-breasted Brush-Cuckoo <i>Cacomantis variolosus variolosus</i> Vigors et Horsfield, 1827 R/V	Kiunga, low/mid-levels of Ok Tedi
Insects (Diptera, Tabanidae)	<i>Chrysops albicincta</i> van der Wulp, 1868	Kiunga
	<i>Chrysops australis papuensis</i> Mackerras, 1964	Kiunga
	<i>Cydistomyia albithorax</i> (Ricardo, 1913)	Feramin (Star Mountains)
	<i>Cydistomyia breviuscula</i> (Walker, 1865)	Feramin (Star Mountains)
	<i>Cydistomyia oldroydi</i> Mackerras, 1964	Kiunga, Fly River
	<i>Cydistomyia heydoni</i> Oldroyd, 1949	Feramin (Star Mountains)
	<i>Cydistomyia ochrothorax</i> Schuurmans Stekhoven, 1926	Feramin (Star Mountains)
	<i>Cydistomyia subhastata</i> (Oldroyd, 1949)	Kiunga
	<i>Cydistomyia torresi</i> (Ferguson et Hill, 1922)	Fly River
	<i>Dasybasis germanica</i> (Ricardo, 1915)	Rouku, (Morehead District)
	<i>Mesomyia (Perisilvius) atrata</i> (Schuurmans Stekhoven, 1926)	Oriomo
	<i>Mesomyia (Perisilvius) demeijerei</i> (Ricardo, 1913)	Upper Fly River, Lake Daviambu, Oriomo
	<i>Mesomyia (Perisilvius) vittata</i> (Ricardo, 1913)	Upper Fly River
	<i>Scapia caliginosa</i> (Walker, 1865)	Oriomo
	<i>Tabanus ceylonicus</i> Schiner, 1868	Oriomo
	<i>Tabanus cohaerens</i> Walker, 1865	Oriomo, Kiunga
	<i>Tabanus innotabilis</i> Walker, 1848	Daru, Fly River delta
	<i>Tabanus recusans</i> Walker, 1859	Daru, Oriomo
	<i>Tabanus serus</i> Walker, 1862	Oriomo
Insects (Diptera, Culicidae)	<i>Anopheles farauti</i> s. s. Laveran, 1902	Coastal
	<i>Anopheles hinesorum</i> Schmidt, 2001 (previously <i>A. farauti</i> No 2)	Widespread
	<i>Anopheles torresiensis</i> Schmidt, 2001 (previously <i>A. farauti</i> No 3)	Mostly in vicinity of Lower Fly River
	<i>Anopheles koliensis</i> Owen, 1945	Upper Fly, Strickland & Bamu rivers
	<i>Anopheles punctulatus</i> Dönitz, 1901	Upper Bamu, & Fly & Strickland tributaries
	<i>Anopheles</i> sp. nr. <i>punctulatus</i>	Mountain foothills
	<i>Anopheles bancrofti</i> Giles, 1902	Coast, Lower Fly & Bamu rivers, Lake Murray
	<i>Anopheles longirostris</i> Brug, 1928	Upper Fly & Ok Tedi tributaries
	<i>Anopheles meraukensis</i> Venhuis, 1932	Lower Fly River, Morehead
	<i>Anopheles novaguinensis</i> Venhuis, 1933	One location, near Weam
	<i>Culex annulirostris</i> Skuse, 1889	Lake Murray, Balimo, Daru, Wando



Table 2 (continuation)

	<i>Culex palpalis</i> Taylor, 1912	Lake Murray, Balimo, Wando
	<i>Culex sitiens</i> Wiedemann, 1828 subgroup	Lake Murray, Balimo, Abam, Daru
Insects (Diptera: Hymenoptera)	<i>Pristaulacus kiunga</i> Jennings et Austin, 2006	Kiunga near Fly River
Acari (Metastigmata)	Unidentified ticks	Lukwi caves, Ok Ma
Annelids (Hirudinida)	? <i>Leiobdella jawarereensis</i> Richardson, 1974	Star Mountains caves
	Unidentified 'pimply skinned' terrestrial leech	Star Mountains caves
	Unidentified leeches	Lukwi caves, Ok Ma

Discussion

Western Province was connected by land with northern Australia until about 8000 years ago when a rise in sea level severed the connection and Torres Strait was formed (Chappell 2005). It follows that some animals, as well as their parasites, are common to both localities. For example, 19 helminths, identified to species, are recorded from the agile wallaby in WP, of which 17 are found in animals in Australia (see Spratt *et al.* 1991) but, of arthropods, only one species (a tick) is known to be shared (see Speare *et al.* 1983) – with the addition of the two species of 'commensal' dung beetles. Monitor lizards on either side of the Torres Strait, also, are known to share nematode parasites, such as *Tanqua tiara* (von Linstow, 1879). With more studies, particularly in WP, more species common to both countries may be found.

A notable feature of the parasite fauna of rusa deer, wild pigs and agile wallabies on Bula Plain is that, although large numbers graze together, there is no interchange of ecto- or endo-parasites between the three groups. While many parasites, like these, demonstrate strong host specificity, utilizing only one or closely related species, others have a broad range of hosts. The parasite with the widest range of hosts within the country as a whole is the cat flea, *Ctenocephalides f. felis* (Bouché, 1835), recorded on five different domestic animals, a rodent, a bat, a marsupial, a bird, as well as man (Owen 2011), but it has been found only on dogs and pigs in WP. This could reflect on a lack of observation. The fleas, *Acanthopsylla enderleini* (Wagner, 1933) and *Orthopsylla uncinata* Hastriter, 2014 have a broad range of hosts in WP's northern border area, the former being recorded on 10 species of rodents and eight species of marsupials and the latter on eight species of rodents. The protozoan, *Sarcocystis* spp. used five different marsupials as intermediate hosts in southern WP, while a tick, *Haemaphysalis bancrofti* Nuttall et Warburton, 1915, parasitized a bird and three marsupial species. The larval (sparganum)

stage of *Spirometra erinacei* (Rudolphi, 1819), a tapeworm of dogs and cats, was found in two varanid species and possibly wild pigs but, so far, the adult worm has not been discovered.

The parasite fauna of many animal groups in WP, particularly amongst lower vertebrates and invertebrates, have received little attention, and the low number of parasites recorded for many other host species in this account is due, probably, to the limited number of individuals examined. No doubt, many parasites, remain to be discovered. This is exemplified by the report of a biodiversity assessment survey of the Hindenburg Wall (part of the Hindenburg Range in the Star Mountains region) (Fig. 2) undertaken in 2013 by a team of international and PNG scientists (Post Courier 2013; Richards & Whitmore 2015). (The area forms part of a proposed series of UNESCO World Heritage Sites in PNG.) Of 656 animal species documented, an estimated 66 species are reported as probably (or suspected to be) new to science, potentially serving as hosts to a range of parasites. WP can be a fruitful ground of study for future biologists and parasitologists.

Over-exploitation of the environment by man, however, is a potential problem. Reports in a local newspaper (Post Courier 2012) of the depletion of wildlife due to over-hunting in the Bula Plain / Bensbach area and, more recently (Post Courier 2020), the uncovering of a poaching ring with a cache of 250 deer antlers and a "huge amount" of dugong bones at Weam, do not auger well for the future if the current trend continues. Planned expansion of mining in the Star Mountains, and logging elsewhere in the province, can also be a concern.

WP has a high biodiversity factor, and its rich wildlife is partly due to the extensive, largely undisturbed, forest cover, and partly to the sparseness of human population. As the parasites of WP fauna form part of this rich biodiversity, it begs the question, when considering conservation of species, should parasites be given the same consideration as their hosts, as advocated by





Figure 4. Representation of a range of ecto- and endo-parasites of animals in Papua New Guinea / Western Province as illustrated, with artistic liberty, by local PNG artist, John Siune [artist's Tok Pisin caption: *Olgita binatan istap insait na outsait wantim ol animal bilong PNG* = All parasites occurring inside and outside of PNG animals]. For legends see next page.



Legends for figure 4: 1 – Head end of a hookworm (nematode); 2 – A larva (cercaria) of a flatworm (digenetic trematode); 3 – A flea; 4 – A tick, such as a cattle tick; 5 – An egg capsule containing eggs of *Dipylidium caninum* (tapeworm); 6 – A ciliated protozoan, such as *Balantidium*; 7 – A long, slender, filarial nematode, such as *Setaria*; 8 – An egg of a thorny-headed (acanthocephalan) worm; 9 – A thorny-headed worm, such as *Macracanthorhynchus*; 10 – A mite; 11 – A louse, such as *Haematopinus*; 12 – A mite, *Sarcoptes*, in its burrow in the skin of its host; 13 – A monogenean (ectoparasitic trematode); 14 – A flagellate protozoan parasite; 15 – A bedbug; 16 – A leech; 17 – An egg of *Ascaris* (nematode); 18 – A thick-walled oocyst of a coccidian (protozoan) parasite of the gut, such as *Eimeria bukidnonensis* of cattle; 19 – A parasitic larva (or maggot) of an insect, such as the screw-worm fly; 20 – The typical form of a parasitic nematode infecting the gut of a host; 21 – A nematode egg containing cells divided to form a larva; 22 – The typical form of a digenetic flatworm, such as the liverfluke, *Fasciola hepatica*; 23 – A pentastomid, a lung parasite, particularly of snakes; 24 – *Trichinella papuae* larvae (nematode) in the muscle fibres of a host; 25 – An egg of an insect parasite, such as a botfly of horses, attached to a host's hair; 26 – A typical tapeworm; 27 – A copepod, such as *Lernaea*, that parasitizes the gills or skin of fishes; 28 – Protozoan parasites, such as *Theileria*, inside red blood cells; 29 – A typical infective larval stage of a nematode gut parasite, such as *Oesophagostomum*.



Figure 5. Some Papua New Guinea / Western Province domestic animals illustrated, with artistic liberty, by John Siune (PNG) [artist's Tok Pisin captions: dok (dog), meme (goat), hos (horse), bullmacau (bull/cow), pik (pig), pato (duck), kakaruk (cockerel/chicken), sipsip (sheep), pwsiket (cat)].



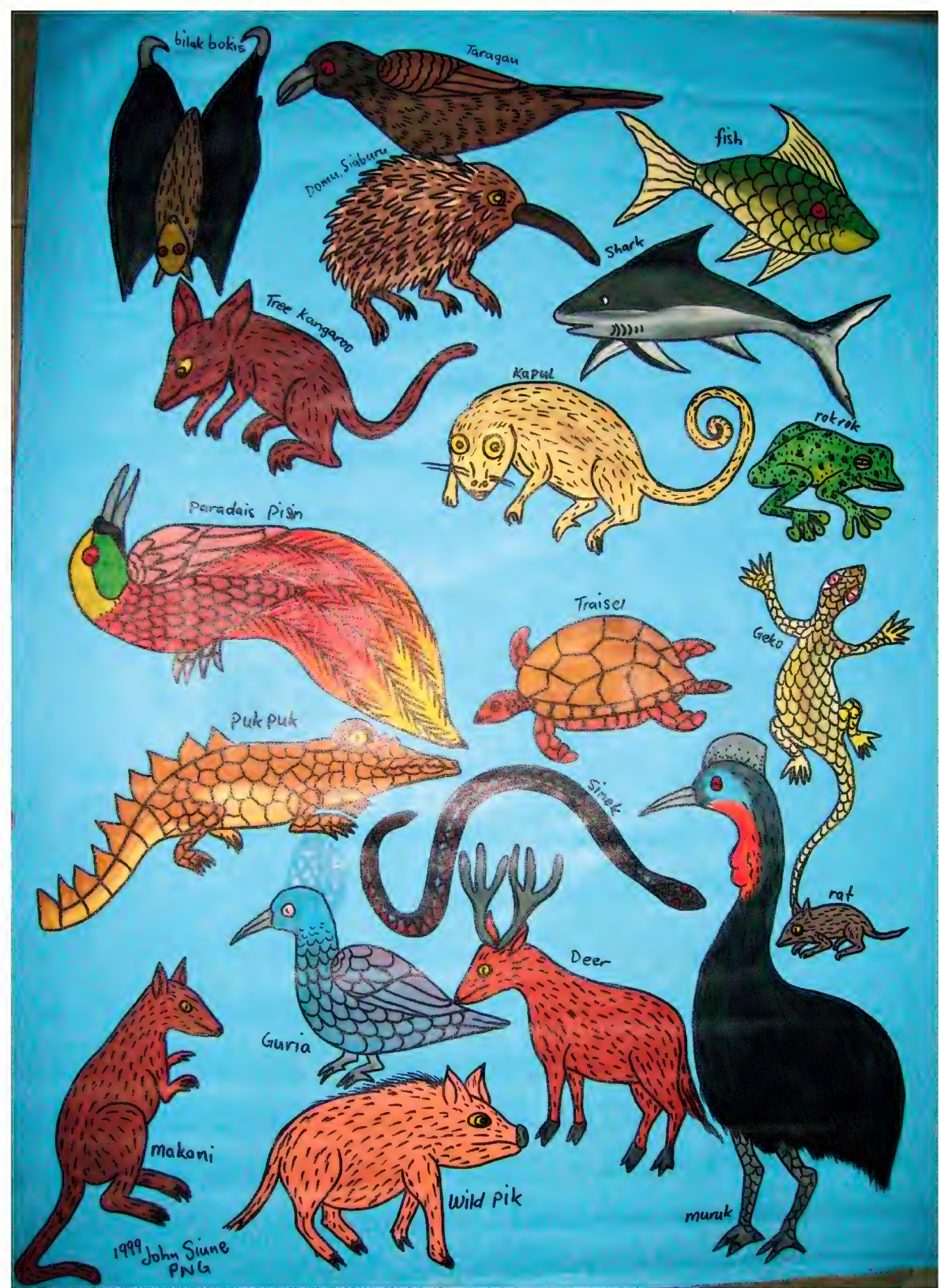


Figure 6. A range of Papua New Guinea / Western Province fauna illustrated, with artistic liberty, by John Siune PNG) [artist's Tok Pisin captions: bilakbokis (fruit bat/flying fox), taragau (bird of prey), domu siaburu (long-beaked echidna - a Simbu language name), kapul (cuscus), rokok (frog), paradais pisin (bird of paradise), traisel (turtle), geko (gecko), pukpuk (crocodile), sinek (snake), makani (wallaby – magani in Motu language), guria (goura pigeon), muruk (cassowary)].

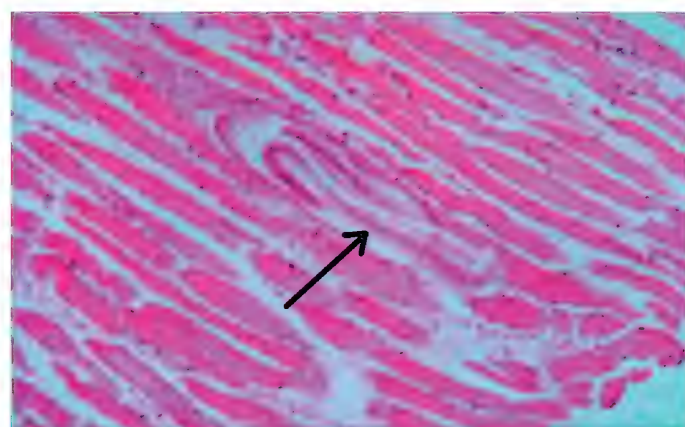




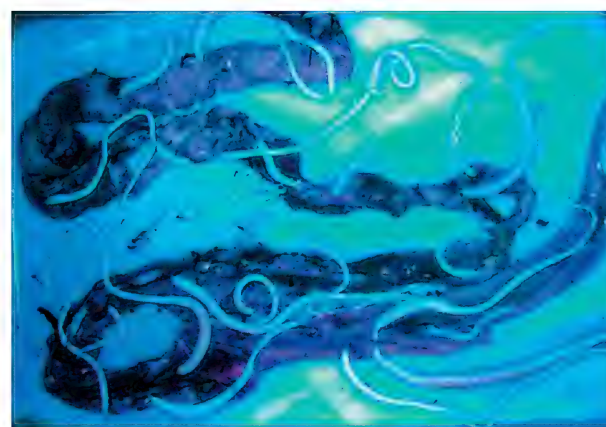
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Figures 7–10. Parasites from the Western Province, Papua New Guinea. 7 – A population of the heartworm, *Dirofilaria immitis*, recovered from the heart and pulmonary artery of a dog in Papua New Guinea; 8 – A population of the digenetic flatworm, *Fischoederius elongatus*, attached to the lining of the rumen (1st stomach) of a Bula Plain rusa deer, *Cervus timorensis*; 9 – A stained section of muscle tissue of a wild pig from Bula Plain showing a *Trichinella papuae* larva (arrowed) within an individual muscle fibre. The absence of a cyst around the larva in this species can make detection difficult; 10 – A portion of the small intestine of a wild pig from Bula Plain opened to show thorny-headed (acanthocephalan) worms, *Macracanthorhynchus hirudinaceus*, attached to the gut lining.

Smales (1994), Windsor (1995), and Durden & Keirans (1996)? Also, to quote Dunn *et al.* (2009), in the context of coextinction – “Although, in the popular view, parasites tend to lack charisma, their loss bears consequences perhaps just as great as those of the loss of their hosts”.

Acknowledgements

Limited resources in PNG has meant that much of the identification of parasites was done by specialists in overseas institutions. My thanks, in particular, go to the staff of the Parasitic Worms Section of the British Natural History Museum, London, namely, David Gibson, Rod Bray, Eileen Harris and the late Stephen Prudhoe, and to Ian Beveridge of the Faculty of Veterinary and Agricultural Sciences, University of Melbourne, for their assistance over many years. Grateful acknowledgement is made also of the assistance

given by the staff of other sections of the Natural History Museum, London, United Kingdom, as well as parasitologists, such as, the late Nixon Wilson and the late T. C. Maa, then of the Bishop Museum, Honolulu, Hawaii, U.S.A., and specialists in other institutions in Australia, New Zealand, Germany, Canada and U.S.A.

In PNG, the technical assistance of the late Columba Awui, National Veterinary Laboratory, is acknowledged as is the assistance given during the surveys by Eric Lindgren, Geoff O’Leary and Geoff Sadler of the then Wildlife Section of DASF, Asmo Pisau, Health Extension Officer, Morehead, villagers of the Bula Plain and staff of the Bensbach Lodge. Thanks also go to Frank Bonaccorso, James Menzies and Lester Seri, for allowing access to examine specimens in their respective institutions or collections, to Eric Lindgren for the use of Fig. 3, and John Siune’s unique artistry is acknowledged.

The great help received from staff of the Science Reading Room, British Library, London,



in obtaining and accessing obscure references during the preparation of this paper, is gratefully acknowledged. Thanks go also to Lesley Smales and Simon Reid in Australia for supplying references.

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Received: 13.iii.2019.

Accepted: 20.xi.2020.

Yorke W., Maplestone P. A. 1926. *The Nematode*

